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ABSTRACT

This packet consists of the instructor and trainee manuals for two courses: practices and procedures of mason tending I and II. The instructor manual for mason tending I contains a schedule for a 40-hour, 5-day course and instructor outline. The outline provides a step-by-step description of the instructor's activities and includes answer sheets to accompany questions on information presented in films, examples, homework assignments, answer sheets to exercises, and directions for hands-on activities. The trainee manual for mason tending I is divided into seven sections. Each section may contain some or all of these components: a list of objectives, terms and definitions, instructional or informational materials, exercises, and worksheets. The sections cover these topics: safety, project planning, scaffold erection, estimating and proper stocking techniques, mortar and grout mixing, tending the mason, and housekeeping and job shutdown. Appendixes include a main glossary and types of bricks. The instructor manual for mason tending II begins with a schedule for a 32-hour, 4-day course. It has the same format as the other manual but also includes an equipment and material list. The trainee manual is divided into six sections: safety; rough terrain forklift operation; masonry saw operation; mortar, grout, and additives; masonry reinforcement; and advanced scaffolding techniques. It follows the same format as the mason tending I course. A glossary of terms is appended. (YLB)

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ED 379 419

Practices & Procedures of Mason Tending I & II

Instructor Manual

TRAINEE

MANUAL

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LABORERS-AGC
EDUCATION AND TRAINING FUND

Practices & Procedures of Mason Tending I

Instructor Manual

Laborers-AGC Education and Training Fund
37 Deerfield Road
Pomfret Center, CT 06259

Course Schedule

Day One AM, Classroom 3.0 hours

- Introduction — .5 hours
- Section I: Safety — 1.5 hours
- Section II: Project Planning — 1.0 hours

Day One, In-field, 1.0 hours

- Section II — 1.0 hours
  Site inspection & planning

Day One PM, Classroom, 2.0 hours

- Section III — 2.0 hours
  Terms, definitions, and safety for ladders & scaffolds

Day One, In-field, 2.0 hours

- Section III — 2.0 hours
  Scaffold set-up & take-down demonstration/lecture

Day Two AM/PM, In-field, 8.0 hours

- Section III — 8.0 hours
  Scaffold set-up & take-down exercises

Day Three AM, In-field, 2.5 hours

- Section III — 2.5 hours
  Scaffold set-up & take-down exercises

Day Three AM, In-field, 1.5 hour

- Section IV — 1.5 hours
  demonstration/lecture on block & brick identification, laying patterns, and reading a wall.

Day Three PM, Classroom, 4 hours

- Section IV — 4.0 hours
  Estimating examples & exercises
  Stocking review

Day Four AM, In-field, 4.0 hours

- Section IV — 1.0 hours
  Stocking demonstration/lecture
- Section IV — 3.0 hours
  Stocking and estimating field exercises

Day Four PM, Classroom, 2.0 hours — 2.0 hours

- Section V, VI, and VII
  lecture and review for all three sections

Day Four, PM, In-field, 2 hours

- Section V, VI, and VII 2.0 hours
  demonstration/lecture on mixing mortar and tending the masons

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Day Five AM/PM, In-field, 8.0 hours

- Sections V, VI, and VII 8.0 hours
  Mixing mortar, tending the masons, project shutdown and clean-up field exercises

MASON TENDING

Introduction

1. Introduce yourself and tell of your background with the Laborers and the training program.

2. Have each trainee introduce himself/herself and tell of their work experience as a laborer.

3. Read through site rules and regulations and explain Training Center protocol.

4. Have class fill out paperwork necessary for expenses, etc..

5. Express importance of communication between foreman and workers. Stress safety as the best reward for good communication. These discussions will help relax the class and help identify
their job attitudes.

Section I: Safety

Instructor Outline
Day One, 8:30-10:00

1. Begin safety discussion by stressing the importance of being safety minded at all times, on and off the job.

2. Stress that laborers must develop a safety awareness and build this awareness into everything they do at the construction site.

3. Construction crews must be familiar with state and federal safety and health regulations and learn to take many safety precautions on the job.

4. Talk about employees rights under OSHA and also their obligations to the employer.

5. Show Film - "We've Got It, Let's Use It".

6. Discuss and highlight, Subpart Q - Concrete Masonry Construction Safety Standards 1926.700 - 1926.706 (pages 4-8 in trainee manual). Discuss the following sections: 1926.700 (b)(4), 1926.701 (b)(e)(f), 1926.702 (a)(j), 1926.706 (a)(b).

7. Develop components for a safety awareness program, ask trainees for input and establish the following:

   a. Personal Protective Equipment (P.P.E.), make list.
   b. Visual Aids such as posters for constant reminders.
   c. Tool box meeting with foreman-10 to 15 minutes, once a week.
   d. Safety training for new employees.
   e. Safety meeting with supervisor once a month or whenever a new job starts.
   f. Report, repair or tag faulty equipment.
   g. Previous experience with accidents.
   h. Good housekeeping procedures.
   i. First Aid training and procedures.
   j. Fire and emergency procedures.
   k. Material Safety Data Sheets (MSDS) for hazardous material identification and precautions.
   l. Job attitude - learn to be safety conscious.

8. Show Film - "Working at Heights Safely". Work and discuss question sheet (page 2 in trainee manual).

9. Safety must be stressed in all areas of training so workers accept such practices and use them on the job.

10. Assign articles 1-5 on pages 8 - 19 for homework.

Instructor's question and answer sheet/guide for the Laborers-AGC Film - "Working at Heights Safely"

1. What are the five areas of priority dangers presented in the film?
   a. Scaffolding **b. Swinging Scaffolds**
   c. Ladders **d. Wall opening or edges of structures**
   e. Floor openings on structures

2. How much weight should a scaffold be able to support?
   Four times its maximum rated load.

3. How should a scaffold be secured to a structure? (Vertically and horizontally)?
   30' horizontally and 26' vertically.

4. How much weight should the cable on a swinging scaffold support?
   6 times the weight of the scaffold.

5. How should the testing of swinging scaffold be done?
   By putting 4 times the maximum load with the scaffold 1 foot off the ground.

6. What is the proper angle for placement of ladders?
   A ratio of 1' - 4'

7. Should loads be carried on ladders? Explain.
   No, Explaination

8. What do guard rails consist of?
   Toe board, mid rail, top rail, 4" toe board, minimum 42" top rail.

9. If guard rail is temporarily removed, what should be done?
   It should be replaced immediately.

10. How should floor opening be protected?
    With standard guard rails or covered with a floor cover of standard strength construction and secured against accidental displacement.

11. Distance between hoist and building should be _____ or _____.
    Ramped or platformed.

12. What personal protective equipment was used in the film pertaining to working a heights safely?
    Safety belts, lanyards and lifelines.

13. When should extraordinary safety precautions be used when working at heights?
    a. Scaffold **b. Swinging scaffold**
    c. Ladders **d. Wall opening or edges of structiores**
    e. Floor openings on structures

Section II: Project Planning - Site inspection and Construction Plan

Instructor Outline,
Day One: 10:00 - 12:00

1. Discuss that planning a construction project begins by contractor inspecting the project site, taking notes, and making sketches. Using information from the site inspection the contractor can start to formulate a plan for site preparation, scaffolding systems, materials and equipment storage, material delivery, schedules and the size of the construction crew.

2. These plans are necessary to complete a project successfully. By using quality construction practices, skilled workers and a very detailed construction plan, a project can be completed on schedule and according to specifications.

3. Explain to trainees the areas of training to be presented during the course, (scaffolding set-ups, stocking, etc.). Inspect the hands-on training area and have the class take notes and measurements and make a rough sketch of the site to include areas of training, (length of wall to scaffold, etc.).

4. Refer trainees to page 23 in the trainee manual. Review or draw a scale drawing of the hands-on training area which includes the class projects.

5. During the site inspection and drawing review, instruct the trainees to begin formulating a construction plan for their class projects. Refer to page 22 in the trainee manual and discuss the construction plan outline.

6. Issue hard hats, eye protection and necessary PPE.

7. Take trainees to hands-on training area and familiarize them with the location of tools, materials and areas of training. Show mason tenders tools and equipment and masonry materials.

8. The construction plan should include the following items:

    - Material storage - location of block, brick, mortar, reinforcing, etc. for easy access
    - Location of mixer - where and how to set up mixer and place sand pile for economy
    - Scaffolding - types of scaffold available, soil base preparation and storage
    - Tending Mason - stocking of block, brick and mortar at ground level and on scaffold
    - Housekeeping - disposal of mortar bags, block pallets, brick packaging, etc.

10. During discussion of the project plan, instruct the trainees to decide on a layout for the items discussed in the construction plan. This will help trainees during site preparation, scaffold erection, and material placement.

11. During the planning stage be sure to remind trainees to build safety practices into their construction plan layout as this will help maintain a constant safety awareness at the jobsite.

12. Project planning must be carried out carefully so as not to leave out any details that may cause accidents, scaffold failure or other project delays.

13. Assign article #6 for homework. (Pages 24-25 in the trainee manual.)

Section III: Scaffold Erection

Instructor Outline
Day 1 - 12:30 - 2:30

1. Show film on Mason Scaffolding

2. Discuss terms and definitions related to scaffolding and identification of parts. Refer to pages 28-29.

3. Discuss and highlight appropriate sections in Subpart L concerning ladders and scaffolding. Pages 30 - 33 in trainee manual.

4. Review pages 34-37 in trainee manual concerning scaffold building and dismantling techniques.

5. Review Section III job sheets on pages 38 -39 in trainee manual concerning inside and outside corner scaffold erection.

6. Assign article #7 pages 40-43 for homework

Day 1 - 2:30 - 4:30

7. Take trainees to hands-on area and demonstrate scaffold erection and dismantling. Dismantle scaffold if already set-up. Begin hands-on training by preparing the soil base and setting the mud sills.

Day 2 - 8:00 - 4:30
Day 3 - 8:00 - 10:30

8. Split trainees into two or three groups for scaffold building exercise. Scaffold erection should
include procedures for:

    a. Inside and outside corners
    b. Proper planking procedures
    c. Installation of guard rails and toe boards
    d. Installation of material landing platform
    e. Proper and safe dismantling and storage of scaffold and plan

9. Rotate trainees through 3 different scaffolding set-ups using mason scaffolds.

10. Erection practice should include initial set-up of scaffold, adding the second level and raising
the planks for masons scaffold.

Instructor Outline
Day 3, 10:30 - 12:00

1. In field demonstration/lecture of what a block is, what brick is, how to measure each, and parts of each.

2. Show and discuss different configurations of block and brick and how to measure each unit.

3. Show examples and discuss laying patterns of block and brick and different types of masonry units.

4. Explain how to read a wall. For example: what size block, where cuts are needed, whatever goes into the wall.

Day 3, 12:30 - 4:30

5. Review terms and definitions in trainee manual on page 46, teach how to estimate materials for the wall (pages 51-52 in trainee manual) including:
   a. Length x height method (by the course)
   b. Length x height method (converting inches or feet into courses)
   c. Estimate without block to read (count) using dimensions only
   d. Square foot method for brick
   e. Square foot method for block using 1.13 block per square foot.

6. Work and review exercises on pages 54-55 in trainee manual.

7. Refer trainees to pages 47-50 in trainee manual Explain and demonstrate how to stock materials at ground level to make work as productive as possible for the masons. Show stocking of block, brick, reinforcing and other necessary materials.

9. Show proper stocking procedures on scaffolds. Be sure to stress safety using the forklift to raise materials and placing materials on the scaffold. Materials must be placed on the scaffold in a position so as not to cause tipping of the scaffold or cause undue stress on scaffold components.

10. Show stocking procedures with block, brick, and both block and brick. Show where to put reinforcing materials, cut block, etc.

Day 4, 8:00 - 9:00

11. In-field demonstration of stocking techniques covered in section IV.

Day 4, 9:00 - 12:00

12. Have trainees layout block in wall to prove proper stocking and estimating techniques and to restock if needed, (at ground level and on scaffold). Continue stocking procedures until all groups are rotated through different set-ups

Instructor's Answer Sheet for Block and Brick Estimating

Total block = T.B.
Regular = Reg.
Bond beam = B.B.

1. **6 courses high**
   40 block long

   How many T.B. 240

2. **8 courses high**
   63 block long

   How many T.B. 504

3. **12 courses high**
   22 block long
   1 course of B.B. in the 12 courses high

   How many T.B. 264
   How many Reg. 242 + B.B. 22

4. **Block 8"x4"x16"**
   44 block long
   40" high
   1 course of B.B.

   How many T.B. 440
   How many Reg. 396 + B.B. 44

5. **Block 6"x6"x16"**
   92 block long
   72" high or 6'
   2 courses of B.B.

   How many T.B. 1104
   How many Reg. 920 + B.B. 184

6. **Block 6"x8"x16"**
   36 block long
   4' high
   1 course of B.B.

   How many T.B. 216
   How many Reg. 180 + B.B. 36

7. **Block 8"x4"x16"**

   240' long= 180 block long
   6'4" high= 19 courses high
   2 courses of B.B.

   How many T.B. 3420
   How many Reg. 3060 + B.B. 360

8. **Block 4"x6"x16"**
   84' long= 63 block long
   36" high= 6 courses high
   1 course of B.B.

   How many T.B. 378
   How many Reg. 315 + B.B. 63

9. **Block 8"x8"x16"**
   100' long= 75 block long
   6' high= 9 courses high
   2 courses of B.B,

   How many T.B. 675
   How many Reg. 525 + B.B. 150

10. **Block 6"x8"16"**
    130' long= 97.5 block long
    4'8" high= 7 courses high
    1 course of B.B.

    How many T.B. 682.5
    How many Reg. 585 + B.B. 97.5

11 Area = 90' wide and 110' long. There are 4 brick to a square foot. How many brick in this area?

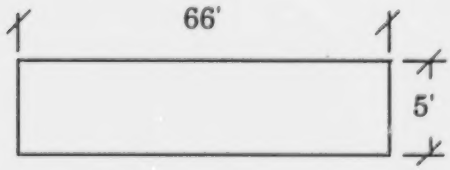
9900 sq.ft. 39,600 brick

12. Area = 4' wide and 250' long. There are 6 1/2 brick to a square foot. How many brick in this area?

1000 sq. ft. 6500 brick

13. It takes 5 1/2 brick to a square foot. How many brick in this area?

330 sq. ft. 1815 brick



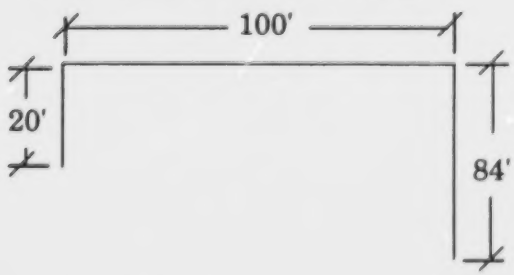
14. You are making a brick patio, 60' wide, 80' long. It takes 3 1/2 brick to a square foot.

How many pallets of brick will it take if there are 500 brick on a pallet? **_33.6 or 334_**

15. What is the total lineal footage of the wall shown below? **_204'__**

How many block will it take to build this wall, 6' high using 6" x 6" x 16" block?

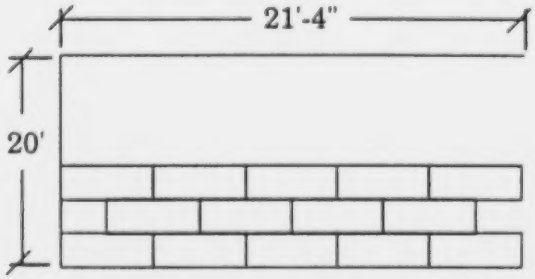
1836 12 courses, 153 long



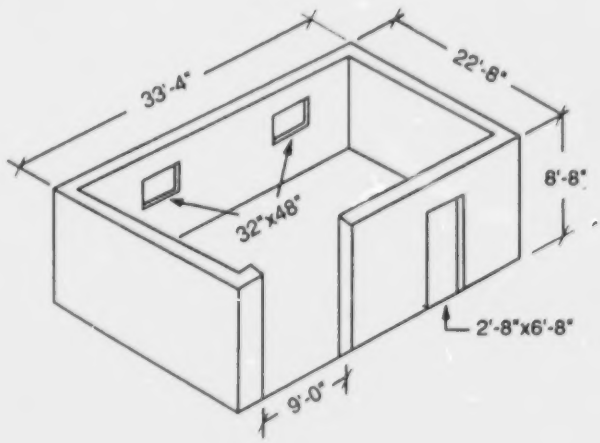
16. How many block will it take to build this wall using 8" x 4" x 16" block *960*

* 4 ft. long equals 3-16" long block.

16 block long x 60 block high



17. How many block and brick will it take to build this garage, using 8" x 8" x 16" block and Jumbo Norman brick?



Section V: Mortar and Grout Mixing
Section VI: Tending the Masons
Section: VII: Project Clean-up and Shutdown

Instructor Outline,
Day 4, 12:30 - 2:30 Classroom

1. Discuss terms and definitions related to mortar and grout mixing page 58. Review pages 59-61 on mixing procedures and include: mixer set-up, mixing ingredients and proportions, PPE, and clean-up.

2. Discuss terms and definitions related to tending the mason to include masons tools and mason tending procedures. Review pages 68-69 in trainee manual.

3. Discuss terms and definitions related to housekeeping, clean-up and job shutdown procedures. Review pages 76-78 in trainee manual, stress importance of housekeeping as a safety precaution against trips and falls.

4. Assign articles 8 and 9 on pages 62-66, and article 10 on pages 70-73 in trainee manual as homework.

Day 4, 2:30 - 4:30

4. In-field demonstration for trainees on how to add mortar ingredients to mixer and the correct order and show desired consistency.

5. Show trainees how to mix mortar by hand using a mud box and mortar hoe including: placing the ingredients and how to mix in the water. Clean-up.

6. Instruct trainees on how to clean mud board, wet mud board, mud down and temper mud; and the duties of a line tender.

Day 5, 8:00 - 4:30 Hands-on for Sections V, VI AND VII

6. Divide trainees into 3 groups. Each group will mix mortar, tend the mason and mix grout.

7. Rotate each group until all groups have done entire sequence of mason tending operations.

8. Housekeeping should be stressed throughout hands-on training to keep the jobsite clean and free of tripping hazards and room for forklift operations and material delivery.

9. Job shutdown and site clean-up should include material and equipment storage and clean-up of tools.

10. Review course and course materials. Write evaluations and course critiques.

11 Area = 90' wide and 110' long. There are 4 brick to a square foot. How many brick in this area?

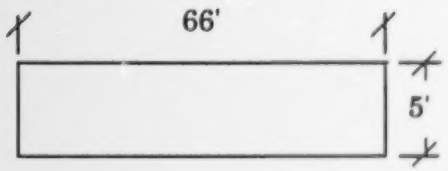
9900 sq.ft. 39,600 brick

12. Area = 4' wide and 250' long. There are 6 1/2 brick to a square foot. How many brick in this area?

1000 sq. ft. 6500 brick

13. It takes 5 1/2 brick to a square foot. How many brick in this area?

330 sq. ft. 1815 brick



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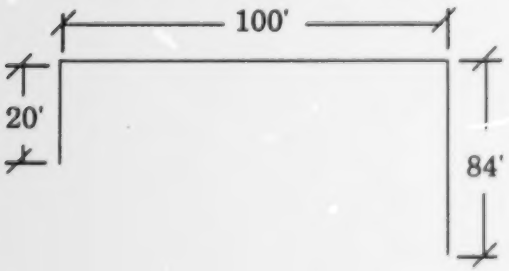
How many pallets of brick will it take if there are 500 brick on a pallet?
33.6 or 334

15. What is the total lineal footage of the wall shown below? **204'**

How many block will it take to build this wall, 6' high using 6" x 6" x 16" block?

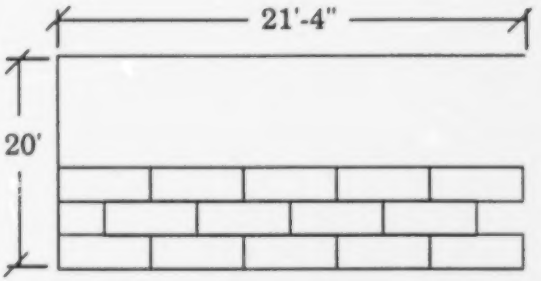
1836 12 courses, 153 long



16. How many block will it take to build this wall using 8" x 4" x 16" block
960

* 4 ft. long equals 3-16" long block.

16 block long x 60 block high



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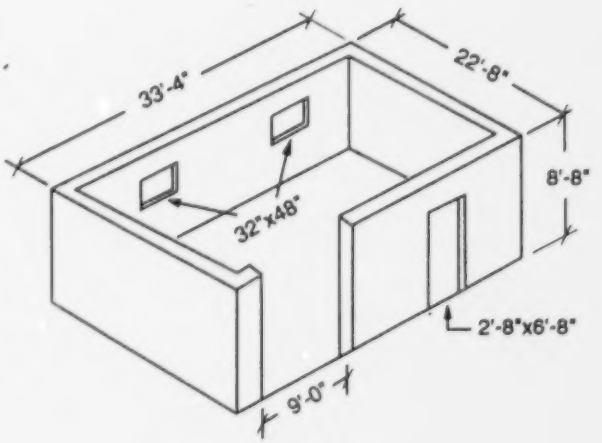

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Practices & Procedures of Mason Tending I

Laborers-AGC Education and Training Fund
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A special thanks is extended to ***Arnie Stoeberl, Art Candelaria,*** and ***Robert Freeman*** for the long hours they spent compiling and editing the information included in this manual.

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Section I: Safety

Page 2	Question sheet for the film *Working At Heights Safely*
Pages 3 - 4	Federal Register, Subpart E, PPE and Lifesaving Equipment
Pages 4 -8	Federal Register, Subpart Q, Concrete and Masonry Construction
Page 9	*Reduce Back Injuries By Lifting Correctly*
Pages 10 -11	*Developing Construction Safety Awareness*
Pages 12 - 14	*OSHA Answers Questions About New Masonry Regulations*
Pages 15 - 16	*Don't Be Another Statistic-Make Safety A Priority*
Pages 17 - 19	*Skin and Health Hazards From Contact with Cement and Concrete*

Trainee Section Objectives

1. To become aware of common construction safety hazards and to develop and display a safety awareness in field exercises and on construction projects.

2. To learn the worker protection rules as specified in the OSHA Federal Register Subparts E and Q.

3. To become aware of common back injuries caused by poor lifting habits and to demonstrate good lifting techniques in field exercises and on construction projects.

"Working at Heights Safely"

1. What are the five areas of priority dangers presented in the film?

2. How much weight should a scaffold be able to support?

3. How should a scaffold be secured to a structure?

4. How much weight should the cable on a swinging scaffold support?

5. How should the testing of swinging scaffold be done?

6. What is the proper angle ratio for placement of ladders? And how far above the landing should ladder extend?

7. Should loads be carried on ladders? Explain.

8. What do guardrails consist of?

9 If guardrail is temporarily removed, what should be done?

10. How should floor opening be protected?

11. Distance between hoist and building should be _____ or _____.

12. What personal protective equipment was used in the film pertaining to working at heights safely?

13. When should extraordinary safety precautions be used when working at heights?

FEDERAL REGISTER PART II

Occupational Safety and Health Administration

29 CFR Part 1926
Concrete and Masonry Construction Safety Standards; Final Rule

Subpart E- Personal Protective and Lifesaving Equipment

Safety belts, lifelines, and lanyards 1926.104
Safety nets 1926.105
Working over or near water 1926.106
Definitions applicable to this subpart 1926.107

1926.104 Safety belts, lifelines, and lanyards.

(a) Lifelines, safety belts, and lanyards shall be used only for employee safeguarding. Any lifeline, safety belt, or lanyard actually subjected to in-service loading, as distinguished from static load testing, shall be immediately removed from service and shall not be used again for employee safeguarding.

(b) Lifelines shall be secured above the point of operation to an anchorage or structural member capable of supporting a minimum dead weight of 5,400 pounds.

(c) Lifelines used on rock-scaling operations, or in areas where the lifeline may be subjected to a cutting or abrasion, shall be a minimum of $^{7}/_{8}$-inch wire core manila rope. For all other lifeline applications, a minimum of $^{3}/_{4}$-inch manila or equivalent, with a minimum breaking strength of 5,400 pounds, shall be used.

(d) Safety belt lanyard shall be a minimum of $^{1}/_{2}$-inch nylon or equivalent, with a maximum length to provide for a fall of no greater than 6 feet. The rope shall have a nominal breaking strength of 5,400 pounds.

(e) All safety belt and lanyard hardware shall be drop forged or pressed steel, cadmium plated in accordance with type 1, Class B plating specified in Federal Specification QQ-P-416. Surface shall be smooth and free of sharp edges.

(f) All safety belt and lanyard hardware, except rivets, shall be capable of withstanding a tensile loading of 4,000 pounds without cracking, breaking, or taking a permanent deformation.

1926.105 Safety nets.

(a) Safety nets shall be provided when workplaces are more than 25 feet above the ground or water surface, or other surfaces where the use of ladders, scaffolds, catch platforms, temporary floors, safety lines, or safety belts is impractical.

(b) Where safety net protection is required by this part, operations shall not be undertaken until the net is in place and has been tested.

(c)(1) Nets shall extend 8 feet beyond the edge of the work surface where employees are exposed and shall be installed as close under the work surface as practical but in no case more than 25 feet below such work surface. Nets shall be hung with sufficient clearance to prevent user's contact with the surfaces or structures below. Such clearances shall be determined by impact load testing.

(2) It is intended that only one level of nets be required for bridge construction.

(d) The mesh size of nets shall not exceed 6 inches by 6 inches. All new nets shall meet accepted performance standards of 17,500 foot-pounds minimum impact resistance as determined and certified by the manufacturers, and shall bear a label of proof test. Edge ropes shall provide a minimum breaking strength of 5,000 pounds.

(e) Forged steel safety hooks or shackles shall be used to fasten the net to its supports.

(f) Connections between net panels shall develop the full strength of the net.

1926.106 Working over or near water.

(a) Employees working over or near water, where the danger of drowning exists, shall be provided with U.S. Coast Guard approved life jacket or buoyant work vests.

(b) Prior to and after each use, the buoyant work vests or life preservers shall be inspected for defects which would alter their strength or buoyancy. Defective units shall not be used.

(c) Ring buoys with at least 90 feet of line shall be provided and readily available for emergency rescue operations. Distance between ring buoys shall not exceed 200 feet.

(d) At least one lifesaving skiff shall be immediately available at locations where employees are working over or adjacent to water.

1926.107 Definitions applicable to this subpart.

(a) "Contaminant" means any material which by reason of its action upon, within, or to a person is likely to cause physical harm.
(b) "Lanyard" means a rope, suitable for supporting one person. One end is fastened to a safety belt or harness and the other end is secured to a substantial object or a safety line.
(c) "Lifeline" means a rope, suitable for supporting one person, to which a lanyard or safety belt (or harness) is attached.
(d) "O.D." means optical density and refers to the light refractive characteristics of a lens.
(e) "Radiant energy" means energy that travels outward in all directions from its sources.
(f) "Safety belt" means a device usually worn around the waist which by reason of its attachment to a lanyard and lifeline or a structure, will prevent a worker from falling.

Subpart Q-Concrete and Masonry Construction

Scope, application and definitions applicable to this subpart. 1926.700
General requirements. 1926.701
Requirements for equipment and tools. 1926.702
Requirements for cast-in-place concrete. 1926.703
Requirements for precast concrete. 1926.704
Requirements for lift-slab operations. 1926.705
Requirements for masonry construction. 1926.706
Appendix A to Subpart Q-References to Subparts of Part 1926

Subpart Q-Concrete and Masonry Construction

Authority: Sec. 107. Contract Work Hours and Safety Standards Act (Construction Safety Act) (40 U.S.C. 333); Secs. 4, 6, and 8, Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, and 657); Secretary of Labor's Order No. 12-71 (36 FR 8754), 8-76 (41 FR 25059) or 9-83 (48 FR 3538), as applicable; and 29 CFR Part 1911.

1926.700 Scope, application, and definitions applicable to this subpart.

(a) Scope and application. This subpart sets forth requirements to protect all construction employees from the hazards associated with concrete and masonry construction operations performed in workplaces covered under 29 CFR Part 1926. In addition to the requirements in Subpart Q, other relevant provisions in Parts 1910 and 1926 apply to concrete and masonry construction operations.
(b) Definitions applicable to this subpart. In addition to the definitions set forth in 1926.32, the following definitions apply to this subpart.
(1) "Bull float" means a tool used to spread out and smooth concrete.
(2) "Formwork" means the total system of support for freshly placed or partially cured concrete, including the mold or sheeting (form) that is in conact with the concrete as well as all supporting members including shores, reshores, hardware, braces, and related hardware.
(3) "Lift slab" means a method of concrete construction in which floor, and roof slabs are cast on or at ground level and, using jacks, lifted into position.
(4) "Limited access zone" means an area alongside a masonry wall, which is under construction, and which is clearly demarcated to limit access by employees.
(5) "Precast concrete" means concrete members (such as walls, panels, slabs, columns, and beams) which have been formed, cast and cured prior to final placement in a structure.
(6) "Reshoring" means the construction operation in which shoring equipment (also called reshores or reshoring equipment) is placed as the original forms and shores are removed, in order to support partially cured concrete and construction loads.
(7) "Shore" means a supporting member that resists a compressive force imposed by a load.
(8) "Vertical slip forms" means forms which are jacked vertically during the placement of concrete.

1926.701 General requirements

(a) Construction loads. No construction loads shall be placed on a concrete structure or portion of a concrete structure unless the employer determines, based on information received from a person who is qualified in

structural design, that the structure or portion of the structure is capable of supporting the loads.

(b) Reinforcing steel. All protruding reinforcing steel, onto and into which employees could fall, shall be guarded to eliminate the hazard of impalement.

(c) Post-tensioning operations. (1) No employee (except those essential to the post-tensioning operations) shall be permitted to be behind the jack during tensioning operations.

(2) Signs and barriers shall be erected to limit employee access to the post-tensioning area during tensioning operations.

(d) Riding concrete buckets. No employee shall be permitted to ride concrete buckets.

(e) Working under loads. (1) No employee shall be permitted to work under concrete buckets while buckets are being elevated or lowered into position.

(2) To the extent practical, elevated concrete buckets shall be routed so that no employee, or the fewest number of employees, are exposed to hazards associated with falling concrete buckets.

(f) Personal protective equipment. . (1) No employee shall be permitted to apply a cement, sand and water mixture through a pneumatic hose unless the employee is wearing protective head and face equipment.

(2) No employee shall be permitted to place or tie reinforcing steel more than six feet (1.8m) above any adjacent working surface unless the employee is protected by the use of a safety belt or equivalent fall protection meeting the criteria of Subpart E of this part.

1926.702 Requirements for equipment and tools

(a) Bulk cement storage. (1) Bulk storage bins, containers and silos shall be equipped with the following:

(i) Conical or tapered bottoms; and

(ii) Mechanical or pneumatic means of starting the flow of material.

(2) No employee shall be permitted to enter storage facilities unless the ejection system has been shut down, locked out, and tagged to indicate that the ejection system is not to be operated.

(b) Concrete mixers. Concrete mixers with one cubic yard (.8m) or larger loading skips shall be equipped with the following:

(1) A mechanical device to clear the skip of materials; and

(2) Guardrails installed on each side of the skip.

(c) Power concrete trowels. Powered and rotating type concrete troweling machines that are manually guided shall be equipped with a control switch that will automatically shut off the power whenever the hands of the operator are removed from the equipment handles.

(d) Concrete buggies. Concrete buggy handles shall not extend beyond the wheels on either side of the buggy.

(e) Concrete pumping systems. (1) Concrete pumping systems using discharge pipes shall be provided with pipe supports designed for 100 percent overload.

(2) Compressed air hoses used on concrete pumping system shall be provided with positive fail-safe joint connectors to prevent separation of sections when pressurized.

(f) Concrete buckets. (1) Concrete buckets equipped with hydraulic or pneumatic gates shall have positive safety latches or similar safety devices installed to prevent premature or accidental dumping.

(2) Concrete buckets shall be designed to prevent concrete from hanging up on top and the sides.

(g) Tremies. Sections of tremies and similar concrete conveyances shall be secured with wire rope (or equivalent materials in addition to the regular couplings or connections).

(h) Bull floats. Bull float handles, used where they might contact energized electrical conductors, shall be constructed of nonconductive material or insulated with a nonconductive sheath whose electrical and mechanical characteristics provide the equivalent protection of a handle constructed of nonconductive material.

(i) Masonry saws. (1) Masonry saws shall be guarded with a semicircular enclosure over the blade.

(2) A method for retaining blade fragments shall be incorporated in the design of the semicircular enclosure.

(j) Lockout/Tagout Procedures. (1) No employee shall be permitted to perform maintenance or repair activity on equipment (such as compressors, mixers, screens or pumps used for concrete and masonry construction activities) where the inadvertent operation of the

equipment could occur and cause injury, unless all potentially hazardous energy sources have been locked out and tagged.
(2) Tags shall read DO NOT START or similar language to indicate that the equipment is not to be operated.

1926.703 Requirements for cast-in-place concrete.

(a) General requirements for formwork. (1) Formwork shall be designed, fabricated, erected, supported, braced and maintained so that it will be capable of supporting without failure all vertical and lateral loads that may reasonably be anticipated to be applied to the formwork. Formwork which is designed, fabricated, erected, supported, braced and maintained in conformance with the Appendix to this section will be deemed to meet the requirements of this paragraph.
(2) Drawings or plans, including all revisions, for the jack layout, formwork (including shoring equipment), working decks, and scaffolds, shall be available at the job site.
(b) Shoring and reshoring. (1) All shoring equipment (including equipment used in reshoring operations) shall be inspected prior to erection to determine that the equipment meets the requirements specified in the formwork drawings.
(2) Shoring equipment found to be damaged such that its strength is reduced to less than that required by 1926.703(a)(1) shall not be used for shoring.
(3) Erected shoring equipment shall be inspected immediately prior to, during, and immediately after concrete placement.
(4) Shoring equipment that is found to be damaged or weakened after erection, such that its strength is reduced to less than that required by 1926.703(a)(1) shall be immediately reinforced.
(5) The sills for shoring shall be sound, rigid, and capable of carrying the maximum intended load.
(6) All base plates, shore heads, extension devices, and adjustment screws shall be in firm contact, and secured when necessary, with the foundation and the form.
(7) Eccentric loads on shore heads and similar members shall be prohibited unless these members have been designed for such loading.
(8) Whenever single post shores are used one on top of another (tiered), the employer shall comply with the following specific requirements in addition to the general requirements for formwork:
(i) The design of the shoring shall be prepared by a qualified designer and the erected shoring shall be inspected by an engineer qualified in structural design.
(ii) The single post shores shall be vertically aligned.
(iii) The single post shores shall be spliced to prevent misalignment.
(iv) The single post shores shall be adequately braced in two mutually perpendicular directions at the splice level. Each tier shall also be diagonally braced in the same two directions.
(9) Adjustment of single post shores to raise formwork shall not be made after the placement of concrete.
(10) Reshoring shall be erected, as the original forms and shores are removed, whenever the concrete is required to support loads in excess of its capacity.
(c) Vertical lip forms. (1) The steel rods or pipes on which jacks climb or by which the forms are lifted shall be-
(i) Specifically designed for that purpose; and
(ii) Adequately braced where not encased in concrete.
(2) Forms shall be designed to prevent excessive distortion of the structure during the jacking operation.
(3) All vertical slip forms shall be provided with scaffolds or work platforms where employees are required to work or pass.
(4) Jacks and vertical supports shall be positioned in such a manner that the loads do not exceed the rated capacity of the jacks.
(5) The jacks or other lifting devices shall be provided with mechanical dogs or other automatic holding devices to support the slip forms whenever failure of the power supply or lifting mechanism occurs.
(6) The form structure shall be maintained within all design tolerances specified for plumbness during the jacking operation.
(7) The predetermined safe rate of lift shall not be exceeded.
(d) Reinforcing steel. (1) Reinforcing steel for walls, piers, columns, and similar vertical structures shall be adequately supported to prevent overturning and to prevent collapse.

(2) Employers shall take measures to prevent unrolled wire mesh from recoiling. Such measures may include, but are not limited to, securing each end of the roll or turning over the roll.
(e) Removal of formwork. (1) Forms and shores (except those used for slabs on grade and slip forms) shall not be removed until the employer determines that the concrete has gained sufficient strength to support its weight and superimposed loads. Such determination shall be based on compliance with one of the following.
(i) The plans and specifications stipulate conditions for removal of forms and shores, and such conditions have been followed, or
(ii) The concrete has been properly rested with an appropriate ASTM standard test method designed to indicate the concrete compressive strength, and the test results indicate that the concrete has gained sufficient strength to support its weight and superimposed loads.
(2) Reshoring shall not be removed until the concrete being supported has attained adequate strength to support its weight and all loads in place upon it.

Appendix to 1926.703(a)(1)
(This Appendix is non-mandatory.)

This appendix serves as a non-mandatory guideline to assist employers in complying with the formwork requirements in 1927.703(a)(1). Formwork which has been designed, fabricated, erected, braced, supported and maintained in accordance with Sections 6 and 7 of the American National Standard for Construction and Demolition Operations-Concrete and Masonry Work, ANSI A10.9-1983, shall be deemed to be in compliance with the provision of 1926.703(a)(1).
(Information collection requirements contained in paragraph (a)(2) were approved by the Office of Management and Budget under control number 1218-0095)

1926.704 Requirements for precast concrete.

(a) Precast concrete wall units, structural framing, and tilt-up wall panels shall be adequately supported to prevent overturning and to prevent collapse until permanent connections are completed.
(b) Lifting inserts which are embedded or otherwise attached to tilt-up precast concrete members should be capable of supporting at least two times the maximum intended load applied or transmitted to them.
(c) Lifting inserts which are embedded or otherwise attached to precast concrete members, other than the tilt-up members, shall be capable of supporting at least four times the maximum intended load applied or transmitted to them.
(d) Lifting hardware shall be capable of supporting at least five times the maximum intended load applied or transmitted to the lifting hardware.
(e) No employee shall be permitted under precast concrete members being lifted or tilted into position except those employees required for the erection of those members.

1926.705 Requirements for lift-slab operations.

In addition to the general requirements of this Subpart, employers engaged in lift-slab operations shall comply with the existing specific requirements for lift-slab operations which are prescribed in ANSI A10.9-1970. These requirements, found in Section 11 of the American National Standard Safety Requirements for Concrete Construction and Masonry Work, ANSI A10.9-1970, are reprinted in the Appendix to this section. In addition there are applicable requirements in 1928.305 (a) and (b) of the Construction Safety and Health Standards which apply to jacks in general, and jacks used specifically in lift-slab construction.

Appendix to 1926.705-Lift-Slab Operations
(Reprinted from ANSI A10.9-1970)
(This Appendix is mandatory)

Section 11. Lift-Slab Operations
11.1 General. The safety requirements and recommendations in Section 11 apply specifically to lift-slab construction operations.
11.2 Design and Planning. Lift-slab operations shall be designed and planned by a qualified professional engineer or architect. Such plans and designs shall include detailed instructions and sketches indicating the prescribed method of erection.

11.3 Jacking Equipment
11.3.1 Jacking equipment shall not be loaded beyond its safe working capacity, and then threaded rods and other members that transmit loads to the jacks shall have a minimum safety factor of 2.5. Jacking equipment used in lift-slab operations shall meet the criteria in 11.3.1 through 11.3.4. (Note: ANSI has interpreted this provision to mean that the safety factory of 2.5 must be met for all jacking components such as jacks, threaded rods, lifting nuts, lifting angles, as well as shearheads, columns and footings.)
11.3.2 Jacks shall be so designed and installed so that they will not continue to lift when overloaded.
11.3.3 Jacks shall be installed with a safety device which will enable them to continue to support the load in any position should the jack malfunction and lose its lifting ability.
11.3.4 The maximum number of manually controlled jacks on one slab shall be limited to 14, and in no event should the number be too great to permit the operator to maintain the slab level within specified tolerances.
11.4 Uniform Lifting. Jacking operations shall be synchronized in such a manner as to insure even and uniform lifting of the slab. During lifting, all points of the slab support shall be kept within one-half inch of that needed to maintain the slab in a level position. If leveling is automatically controlled, a device shall be installed which will stop the operation when the one-half inch tolerance is exceeded or when there is a malfunction in the jacking system. If level is maintained by manual controls, such controls shall be located in a central location and attended by a trained operator while lifting is in progress.
11.5 Falling Hazard. No one shall be permitted under the slab during jacking operations. (Note: ANSI has interpreted this provision as follows: "No one is permitted in the building during jacking operations except those employees required for the jacking operation and to secure slabs.)

1926.706 Requirements for masonry construction.

(a) A limited access zone shall be established whenever a masonry wall is being constructed. The limited access zone shall conform to the following.
(1) The limited access zone shall be established prior to the start of construction of the wall.
(2) The limited access zone shall be equal to the height of the wall to be constructed plus four feet, and shall run the entire length of the wall.
(3) The limited access zone shall be established on the side of the wall which will be unscaffolded.
(4) The limited access zone shall be restricted to entry by employees actively engaged in constructing the wall. No other employees shall be permitted to enter the zone.
(5) The limited access zone shall remain in place until the wall is adequately supported to prevent overturning and to prevent collapse unless the height of wall is over eight feet, in which case, the limited access zone shall remain in place until the requirements of paragraph (b) of this section have been met.
(b) All masonry walls over eight feet in height shall be adequately braced to prevent overturning and to prevent collapse unless the wall is adequately supported that it will not overturn or collapse. The bracing shall remain in place until permanent support elements of the structure are in place.

Reduce Back Injuries By Lifting Correctly

by: Ward R. Malish
Editorial Director of Aberdeen's *Concrete Construction Magazine*

Back injuries are costly. Workers pay the highest price, enduring pain and coping with disabling effects. The employer pays too, for workers' compensation claims, increased insurance rates, and lost productivity. Because many back injuries are caused by lifting, the costs can be reduced by showing workers how to avoid lifting mistakes.

Common lifting mistakes

The first mistake is assuming that back injuries are caused by a single lift. Common back disorders are more likely to be caused by improper lifting performed over a period of time. Picking up rebar, bags of cement, or other heavy loads the wrong way, day after day, increases the chances for injury even though pain may not set in for years. Because there's no pain, some workers ignore advice about lifting and repeatedly make the same mistakes. But they pay the price years later. Other mistakes are in the mechanics of lifting. Most poor lifting methods put strain on the back instead of the legs. These are the most common mistakes:

- *Bending the back forward and keeping legs straight during lifting.* This puts lots of stress on the lower back.
- *Bending and twisting at the same time.* This too puts maximum stress on the lower back. It doesn't allow you to pivot the feet or squat to lift.
- *Using fast, jerking motions.*
- *Handling the load too far from your body.* With an object at arm's length, stress on the back increases 7 to 10 times.
- *Trying to lift a load that's too heavy.* Even the right lifting methods won't help if the object is too heavy to be lifted safely.

Figure 1-1
The one knee lift allows the worker to bring a load closer to the body before lifting it. Workers with knee problems shouldn't use this lift, but it's encouraged for those who don't have good arm strength.

Lifting the right way

Test the load before lifting. If it's too heavy, get help or use a forklift or other lifting device. Plan each lift. Check the area to make sure there's enough room to lift, a clear path for carrying the load, and a cleared space for putting it down.

Use a shoulder-width, balanced stance with one foot ahead of the other. Keep the lower back in its normal arched position while lifting and bring the load as close to the body as possible. Bending at the knees or dropping to one knee helps get the load close (see Figure 1-1). Keep head and shoulders up and tighten stomach muscles as the lifting motion begins. Lift with the legs and stand up in a smooth, even motion. To change directions, move the feet (pivot) instead of twisting.

Remember, poor lifting habits may not cause discomfort immediately, but the effects do add up. Each wrong-way lift is a deferred pain.

Developing Construction Safety Awareness

Corporate programs centered on the individual worker

By: Raymond A. Jurewicz
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Construction is one of our most hazardous industries. Injuries, illnesses, and fatalities in construction are 54% higher than the national average for all industries. Accidents in the $137-billion industrial, utility, and commercial construction market recently cost $8.9 billion, or 6.5% of the total annual construction dollars (Ref. 1). This clearly indicates, putting aside humanitarian interests and legal obligations, that it makes good business sense to study the causes of accidents and ways to prevent them.

The costs cited are totals including both direct and indirect items. The direct costs include:

- Workers' compensation
- Liability
- Property damage

Indirect costs of accidents include a number of factors such as:

- Loss of productivity
- Disrupted construction schedules
- Administrative time for investigation and reports
- Training of replacement personnel
- Wages to injured workers and other workers for time not worked
- Cleanup and repair
- Adverse publicity
- Third party liability claims
- Equipment damage

These indirect costs are estimated to be from 4 to 17 times as large as the direct costs. With the stakes so high, both large and small construction companies should make a serious effort to improve their safety records. Some methods we have found helpful are described here.

The safety handbook

Our company has been in the formwork business for many years and knows the hazards of formwork. We have prepared a handbook specifically outlining many of the formwork hazards. We give a copy to all new employees and ask them to indicate that they have read and understood the material by signing a statement to this effect. Admittedly this does not guarantee that all employees have read and understood the material, but it does help with many new employees.

Meetings and posters

Another useful way of pointing out safety problems is through weekly safety meetings on the job. Although these meetings usually last only about 5 minutes, we can discuss a wide range of topics concerning safety on a particular project. This is a more direct form of communication and is probably more effective.

Safety posters in the job trailer and inside gang tool boxes can serve as reminders if they are noticed after they are initially put up. Changing a poster regularly is more effective than leaving the same one in place for a long time.

Safety Awards

If your work crew is steady or if the job you are working on will last a long time, individual safety awards can be used. Items such as caps, T-shirts, belt buckles, pocket knives, and safety shoes can be used as awards for various lengths of time worked without an accident. Our company uses a 3-month period.

Individual safety awards are good, but they cause the employees to look out only for themselves. Another concept that can be used effectively is the group safety award. With this idea a job or crew on the job, depending on the size of the job, can earn an award by having no accidents for a certain period. These awards can include coffee and doughnuts at break, hamburgers or chicken for lunch, or maybe a little get-together after hours. The advantage of this type of plan is that the newly hired are carefully looked after, especially if it's only a short time before the award is to be received.

Motivating the foreman

Motivating workers to work safely on their own is one thing; motivating the foreman to make sure that workers work safely is another. Regular foreman safety meetings in which any previous accidents are discussed and where safety ideas and techniques are once again re-emphasized can be effective. Safety awards to the foremen for meeting specific safety goals on the job can also be used.

Cost of safety programs

There are problems associated with safety programs. Records must be kept to determine who is eligible for an award, and when. This becomes even more difficult in construction where a worker may work intermittently on your jobs. There is also the problem of purchasing, distributing, and storing the awards. Once the awards arrive at the jobsite, it appears that everyone, whether your employee or not, wants one. Control of the awards must be maintained if they are to mean anything.

Safety programs of any sort cost money. Measuring the effectiveness of a safety program after it has been in effect for some time is difficult. How can you calculate the amount of money saved because of an accident that didn't happen?

A commitment to safety

A safe work place requires more than just luck; a commitment must be made by workers and management at all levels. Prudent managers will make the commitment, not just for humanitarian reasons nor because safety is mandated by law, but also because a good safety program makes sense in terms of dollars and cents.

References

1. "Improving Construction Safety Performance," Report A-3, Construction Industry Cost Effectiveness Project, The Business Roundtable, 200 Park Avenue, New York, New York, January 1982.
2. Hurd, M.K., Formwork for Concrete, SP-4, Fourth Edition, American Concrete Institute, Detroit, Michigan, 1981.
3. Jurewicz, Raymond A., "Worker Safety in Formwork Operations," Concrete Construction, March 1988, page 303-10.

OSHA answers questions about new masonry regulations

Insight on how OSHA will enforce new requirements for limited access zones and bracing of masonry walls.

During August of 1988, the Occupational Safety and Health Administration (OSHA) imposed new standards for masonry construction. Two new requirements were added: a limited access zone on the unscaffolded side of the wall; and for walls more than 8 feet high, adequate bracing until the permanent supporting elements of the structure are in place. The new rules have left masonry contractors with many questions on how OSHA will interpret and enforce them.

OSHA REQUIREMENTS FOR MASONRY CONSTRUCTION
Enacted August 15, 1988

(a) A limited access zone shall be established whenever a masonry wall is being constructed. The limited access zone shall conform to the following.

(1) The limited access zone shall be established prior to the start of construction of the wall.
(2) The limited access zone shall be equal to the height of the wall to be constructed plus 4 feet, and shall run the entire length of the wall.
(3) The limited access zone shall be established on the side of the wall which will be unscaffolded.
(4) The limited access zone shall be restricted to entry by employees actively engaged in constructing the wall. No other employees shall be permitted to enter the zone.
(5) The limited access zone shall remain in place until the wall is adequately supported to prevent overturning and to prevent collapse unless the height of the wall is over 8 feet, in which case, the limited access zone shall remain in place until the requirements of paragraph (b) of this section have been met.

(b) All masonry walls over 8 feet in height shall be adequately braced to prevent collapse unless the wall is adequately supported so that it will not overturn or collapse. The bracing shall remain in place until permanent supporting elements of the structure are in place.

LIMITED ACCESS ZONE

CMCA: Which employer is responsible for establishing the limited access zone?
OSHA: The employer(s) whose employees are exposed is responsible for establishing the zone. This doesn't mean that the exposing employers must actually mark off or barricade the zone. They must, however, ensure that there is a zone and that the wall is braced or otherwise supported to protect their exposed employees.

Similar requirements exist elsewhere on the construction site. For instance, employers whose employees use electrical power must ensure the circuit is grounded even though another contractor may have to do the grounding. Also, the employer whose employees are exposed to inadequate ventilation must ensure his employees are protected even though another contractor may have to install the ventilation system. Legal responsibility for compliance rests with the employer whose employees are exposed.

CMCA: If the masonry contractor's employees are allowed in the limited access zone, how can the masonry contractor be cited?
OSHA: The only employees permitted in the zone are those "actively engaged in constructing the wall". As with other contractor's employees, if the masonry contractor's employees are "actively engaged in constructing the wall", he will not be cited. But if the masonry contractor's employees are not actively engaged in constructing the wall, he will be subject to citation. For example, if the contracts or specifications require the electrical or plumbing contractors to install conduit or piping in the wall during its construction, they would be

considered "actively engaged in constructing the wall" and not cited. If, however, conduit or piping doesn't have to be installed while the wall is being constructed, the electrical or plumbing contractor would be cited for exposing his employees in the access zone.

CMCA: If only employees of other contractors are exposed to a wall and no limited access zone has been established, can the masonry contractor be cited for not establishing the zone?
OSHA: The masonry contractor may or may not be cited, depending on whether or not he met OSHA's "Legitimate Defense Test". To determine this, certain questions must be answered:

(1) Who created the hazard?
(2) Who had the authority or the ability to correct the hazard?
(3) Was there reasonable effort made to persuade the controlling contractor to correct the hazard?
(4) Did the exposing employer instruct or train his employees on how to avoid or minimize dangers associated with the conditions?

If the exposing employer took all possible actions to protect his employees, short of walking off the job, OSHA would not cite that employer. However, OSHA might cite the employer(s) who was in the best position to correct the hazard.

For example, if a masonry contractor uses an ungrounded electrical system and makes no effort to get the hazard corrected, OSHA would cite the masonry contractor even though he didn't create or have the ability or authority to correct the hazard. But if the masonry contractor made a "reasonable effort" to persuade the controlling contractor to correct the condition, and all other parts of the legitimate defense test are met, the masonry contractor would not be cited. The "reasonable effort" means in writing or other provable means.

Likewise, if employees of another contractor are exposed to a masonry wall for legitimate reasons, the masonry contractor would be cited if he was asked to correct the hazard and failed to do so.

CMCA: What happens if the masonry contractor is required to build a wall on a property line?
OSHA: Employers generally will be cited for a violation or hazard to which their employees are exposed. For a wall being built on a property line, if no employees are exposed, no citations would be issued. But if employees are exposed to a potential wall collapse and they are not protected, their employer would be cited.

Locating a wall on a property line certainly restricts or prevents establishment of a limited access zone. Therefore, if employees are exposed, the wall may have to be braced or otherwise supported even if it's less than eight feet high. This same rule applies if the activities of the general contractor or other subcontractors make it impossible to reserve the full space required for the limited access zone.

CMCA: How large does the limited access zone have to be when the wall of the building gets several stories high?
OSHA: The key word in determining the size of the limited access zone is "unsupported". Base the size of the zone on the height of the "unsupported" portion of the wall. For example, if a wall under construction is 80 feet high and all but 10 feet of that height is supported, the limited access zone should be 14 feet (the unsupported height + 4 feet).

CMCA: What methods are acceptable for creating a limited access zone? Does it require barricades, signs, or markings on the floor or ground?
OSHA: The standard sets no specific requirements for how the zone should be designated. Any marking or barrier is acceptable as long as the intent of the standard is met. An ideal condition would be a physical barrier and signs. However, the employer establishing the zone may identify the zone as he wishes. He may draw lines, post signs, or erect barricades. Whatever method he chooses, he must be sure the limited access zone will be clearly recognizable to other workers approaching the area. If an OSHA compliance officer finds that the intent of the standard is not met, he may cite the employer.

CMCA: Must the initial size of the limited access zone be based on the ultimate height of the wall? Or can the zone be smaller when the wall is low and increased as the wall is built higher?
OSHA: The zone size must fulfill the intent of the standard. If the ultimate height of the wall will be 15 feet, but it is only 5 feet high when the OSHA compliance officer is at the site, a zone of at least 9 feet is required. However, when the wall height increases from 5 to 6 feet, the zone must immediately be extended to at least 10 feet or the exposing employer would be in violation. Establishing the zone at the beginning of the job based on the ultimate height of the wall may be more practical than moving barricades or signs each time the wall height increases.

CMCA: Won't a limited access zone inside a building severely impair, if not totally restrict, activities of other subcontractors?
OSHA: The ultimate objective of this standard is to prevent masonry walls from collapsing onto exposed workers. This can be done by supporting or bracing the walls, by restricting exposure within the probable fall path of the walls, or by providing a place of escape beyond the probable fall path of the walls. Which method is used is up to the employer(s). No one course of action is acceptable in all situations, but some action must be taken to prevent serious injury or death from a collapsing wall. Finding an effective solution demands coordination and cooperation of the general contractor and subcontractors.

CMCA: Can the limited access zone be removed after the walls are braced?
OSHA: Yes.

BRACING

CMCA: What does OSHA consider "adequate" bracing?
OSHA: No definition of "adequate" fits all situations. The employer must decide what is adequate bracing and he should be able to support his decision. One 8-foot-high wall may require more bracing or different bracing than another 8-foot-high wall. Many factors determine the necessary bracing: wind strength, wind direction, terrain, and others. The intent of the new regulations is to prevent the wall from collapsing onto workers. Therefore, the employer must provide bracing capable of supporting the wall under prevailing conditions.

CMCA: The standard requires a wall 8 feet high to be braced. Does that mean masons must stop work when the wall reaches 8 feet high and move to another work area, if available, or go home while bracing is installed?
OSHA: The standard requires walls more than 8 feet high to be adequately braced unless the wall is adequately supported to prevent overturn or collapse. The employer is responsible for determining the adequacy of the wall support or bracing. If the employer considers a wall 8 feet or higher "adequately supported", then no bracing is required. But the employer should be prepared to substantiate his determination.

The standard doesn't intend to change wall construction practices, except to ensure safety for all people exposed. It requires bracing only when the wall is not adequately supported to prevent collapse. If a "green" masonry wall is more than 8 feet high and bracing would be detrimental to its construction, then the limited access zone should remain in place to ensure worker safety.

CMCA: If a wall is not braced properly, which employer is cited? Is it the masonry contractor? What bearing does a construction contract have on which employer might receive a citation?
OSHA: A construction contract does not have any bearing on which employer(s) receives a citation. The employer(s) cited usually will be the employer(s) whose employees are exposed to the violation or hazard. This general rule has some exceptions and two frequently are applied: One is the Legitimate Defense Test that was discussed earlier. The other is unpreventable employee misconduct or the "isolated event".

The second exception is allowed when the violating conduct of the employee was 1) unknown to the employer (considering employer's reasonable diligence) and 2) in violation of the employer's work rules that were effectively communicated and uniformly enforced.

Don't Be Another Statistic - Make Safety a Priority

TABLE 1-1: ACCIDENTS AND LOST WORKDAYS, 1986

	Cases[1] per 100 Workers	Lost Workdays per 100 Workers
Masonry, stonework, plaster	17.2	176.0
All construction	15.2	134.5
All private industry nationwide	7.9	65.8

[1] Cases are reported incidents in which injuries or death occurred.

Source: National Bureau of Labor Statistics, 911 Walnut, Suite 1604, Kansas City, Missouri 64160 (816-426-2481).

If you need a reason to implement and enforce safe work practices, take a look at the numbers. Table 1-1 shows that accidents happen more often and cause more lost workdays for masonry, stonework, and plaster work than for the construction industry at large and for all private industry nationwide. As Table 1-2 shows, these rates do not change much from year to year.

Masonry jobsites aren't becoming more dangerous from year to year, but they're also not becoming safer. What is causing most of the accidents?

Statistics for masonry construction jobs are not available. But the main causes behind the fatalities that occur in the entire construction industry are: 1) vehicle accidents, 2) sprains, strains, and back injuries, 3) fractures, bruises, and cuts.

Unsafe job practices lead to accidents and lost workdays. Table 1-3 (on page 16) shows the unsafe practices for which masonry contractors are most often cited by the federal Occupational Safety and Health Administration (OSHA). One-third of the citations are scaffold-related violations. At least 10% of the citations are written because employees did not wear protective clothing or use personal protective equipment. In 1987, federal OSHA made 2,340 inspections of masonry construction jobs. Of these, 72% resulted in at least one citation. Twenty-five of the inspections were promoted by a jobsite death or an accident that hospitalized five or more people. In all, federal OSHA cited 4,197 violations totalling $695,915 in penalties. Half these violations were classified as serious, willful, or repeat (SWR). The top 20 OSHA violations listed in Table 3 account for 78% of the citations written.

How do you lower the number of citations and the number of accidents and lost workdays? Make safety a priority. A study of 178

TABLE 1-2: ACCIDENTS AND LOST WORKDAYS FOR MASONRY, STONEWORK, AND PLASTER, 1980-86

Year	Cases[1] Per 100 Workers	Lost Workdays Per 100 Workers
1980	16.2	137.5
1981	15.8	138.6
1982	15.0	120.0
1983	15.8	124.7
1984	17.3	154.2
1985	16.6	150.9
1986	17.2	176.0
7-year average	16.3	143.1

[1] Cases are reported incidents in which injuries or death occurred.

Source: National Bureau of Labor Statistics

TABLE 1-3 THE TOP 20 SAFETY VIOLATIONS MASONRY CONTRACTORS WERE CITED FOR BY FEDERAL OSHA IN 1987

Rank	Number of Citations	SWR[1] Rank	Violation (OSHA Standard)
1	686	1	Scaffold doesn't have both top rail and mid-rail, not fully cross-braced, or not set on base plates. (1526.451 d)
2	562	2	Unstable objects used to support scaffold, no guardrails when scaffold is 45 inches in either horizontal direction, planking not overlapped a minimum of 12 inches or secured from movement, no access ladder or equivalent safe access provided, or planks extended over their end supports less than 6 inches or more than 12 inches. (1926.100 a)
3	224	3	Head protection not worn. (1926.100 a)
4	171	-	No OSHA poster. (1903.002 a)
5	163	6	Ladder not secured from movement, ladder side rails not extended 36 inches above the landing, or defective ladder used. (1926.450 b)
6	141	4	Employees working next to an open-sided floor that does not have both mid-rail and top rail. (1926.500 d)
7	134	9	Electrical equipment not protected by ground fault circuit interrupters or an assured equipment grounding conductor program. (1926.404 b)
8	119	5	Employees not protected by safety belts and life lines when on swinging scaffold, no tie backs for roof hooks, no guardrails on swinging scaffolds, rope used for suspension not able to support six times the rated load, or counterweights not four times the rated load. (1926.451 i)
9	114	-	Flammable liquid not stored in safety cans or flammables stored near stairs or exits. (1926.152 a)
10	111	15	No accident prevention program. (1926.020 b)
11	104	7	Personal protective equipment not used to protect employees. (1926.028 a)
12	99	18	Poor housekeeping. (1926.925 a)
13	97	8	Tools used without guards, mortar mixers not protected with current manufacturer guard, or rotating moving parts of machinery not guarded. (1926.300 b)
14	92	14	Ungrounded tools and equipment used. (1926.404 f)
15	88	11	Employees cut brick or block without eye protection. (1926.102 a)
16	85	11	Employees not trained in OSHA standards. (1926.921 b)
17	79	-	OSHA 200 form not available. (1904.002 a)
18	78	-	Temporary wiring not grounded, no guards on temporary lighting, or extension cords not rated for hard/extra-hard usage. (1926.405 a)
19	59	10	Unguarded floor holes or floor openings. (1926.500 b)
20	59	-	Motor vehicles have no back-up alarm or have cracked glass. (1926.601 b)
21-171	932	-	151 other paragraphs of the code were cited.

[1] Ranked from the most to the fewest citations written for Serious/Willful/Repeat (SWR) violations.

Source: Federal Occupational Safety and Health Administration (OSHA) statistics for masonry contractors. These statistics do not include municipal workers because they are exempt from federal OSHA inspections.

companies by Du Pont Safety Services showed that lost workdays can be reduced by an average of 37% in the first year a safety program is set up. Lost workdays will continue to drop in subsequent years, but at a slower rate. By the third year of an active safety program total improvement averages 59%. By the sixth, it averages 89%.

To make safety a priority, a company must:

- Commit money and people to safety
- Give safety the same importance as quality and productivity
- Stress management's role in safety
- Make safety more effective through organizational changes

Regardless of company size, location, or industry classification, one point is clear: the higher the priority you place on safety, the greater the improvements in safety.

Skin and Health Hazards From Contact With Cement and Concrete

Cement, when it comes in contact with the skin, has a burning effect causing drying and cracking which in some individuals may lead to a serious case of secondary infection. It has two properties which produce an irritating action on the skin. One being that it is hygroscopic (capable of absorbing water) and the other is that it is alkaline which gives it a caustic effect.

The defense mechanisms of the skin can withstand the action of water and even fairly strong acid, but they are attacked by strong alkalis. Perspiration normally dilutes water-soluble irritants, but under certain conditions it may promote the action of irritants on the skin. Workers who perspire excessively are more likely to develop dermatitis (skin inflammation) from solid substances such as cement. There is always lime in the cement, and the more lime the more caustic effect it has on the skin.

Cement dust is ordinarily classified as a nuisance dust with a permissible exposure limit of 15mg per cubic meter under OSHA regulations.

The essence of all prevention of industrial dermatitis is to prohibit skin contact with possible irritants, or if this is not possible, the earliest removal of the irritants from the skin. Prevention of contact is accomplished by using protective clothing and protective creams.

Men working at jobs such as operating a screed should wear protective gloves and adequate rubber boots. Care should be taken that the interior of the gloves and boots are kept clean. Severe cement burns have resulted when workmen have continued working in cement with a crack or a hole in their boot. If cement should get inside a boot or shoe, the footwear should be removed as soon as possible and the cement washed from the skin.

Excessive perspiration combined with friction also macerates the skin, lessening resistance to external irritants. The grains of sand or gravel used in the concrete mix also can be irritating, even though the skin is not broken or cracked in any area.

When the water is added to the cement a chemical reaction takes place changing the lime from calcium oxide to calcium hydroxide, producing heat in the reaction. Dry cement coming into contact with the hands absorbs moisture from the skin and causes the skin to become hard and dry. In some cases it causes the skin to thicken resulting in severe cracks which may bleed. These cracks are always a source of secondary infection.

Cement not only affects the skin, but it also has a marked action on the fingernails, causing them to become dry and brittle. Persons who perspire freely are more likely to be affected by the dry cement. This is the reason that in some cases there is less action on the skin in the winter time than during the hot summer months.

Frequent locations of cement dermatitis in addition to hands and feet are the wrists, neck, and waist. This is caused by cement on the clothing being rubbed against the skin by close fitting clothing. There have been many cases of cement dermatitis on the front of the body where the handle of a hand buggy was covered with wet cement.

Recommendations to eliminate contact with the skin of both wet and dry cement:

1. That boots, gloves, and clothing impervious to moisture be used while working with wet concrete or cement.
2. That protective creams be used on the hands if gloves are not readily available.
3. That the interior of boots be washed after each use with soap and water, and thoroughly rinsed with clean water.
4. That someone be placed in charge of the protective clothing, and he or they ascertain if the protective clothing shows any rips or tears which might allow the cement to come in contact with the wearer's body.

5. That where cement buggies are used, a rubber apron be supplied to prevent the buggy handle from rubbing cement into the skin.

Concrete Hazards

Dust

Concrete is a mixture of portland cement and gravel. It is often necessary to grind, drill, and chip concrete, which causes a significant amount of dust. Control dust through wetting, mechanical exhaust ventilation, and personal protective equipment or respirators.

Dermatitis

Working with wet concrete can cause cement dermatitis. Prevent this by wearing gloves, long sleeve shirts, proper boots, and rubber aprons. Cement workers should wash regularly during the placement. Foremen must ensure adequate washing facilities are available and encourage workers to wash up.

Form oils

Form oils are used on wood forms to prevent concrete from adhering to them. Form oils are generally petroleum fuels and diesel oil sprayed on the forms. These pose a relatively low health risk. However, special form oils can contain isopropyl alcohol or other solvents which increase the health risk as well as the fire hazard.

The sprayer creates an oil mist which may be inhaled. Inhaling this mist over a period of time can cause respiratory irritation. Therefore, the use of respirators should be considered before each application.

Form oils generally are stored in 55-gallon drums and dispensed by gravity feed. Store the drums in a cool, dry place out of direct sunlight. Good ventilation is important since these liquids are combustible. Prohibit all ignition sources, which include cigarettes, around the containers.

The greatest concern with form oils is skin or eye contact. Most fuel oils are skin irritants. Avoid contact with form oils by wearing protective gear, gloves, and safety glasses.

Toxic Fumes

Some precast construction requires a considerable amount of welding. Fumes generated from welding may contain iron oxide and other toxic metals. Use ventilation and respirators to combat this problem.

Hearing Loss

Many operations in precast work involve noise at high levels. These levels should not exceed the eight-hour TWA of 90 dBA. Engineering controls, hearing protection and worker rotation can be used to avoid hearing damage.

Concrete Surface Preparation Hazards

Chemical Burns

Sandblasting is often used to clean or remove stains on concrete or mortar. Muriatic acid is sometimes used, also. This can cause chemical burns to the skin and eyes. Wear protective garments, gloves, and face shields with safety glasses when using acids.

Use a plastic or rubber pail to mix muriatic acid with water. Water added to acid can cause a violent reaction. Always add the acid to the water. Never vice versa.

Breathing Hazards

Grinding and sandblasting concrete causes breathing hazards. Sandblasting sand contains almost pure silica. If inhaled, silica can cause silicosis, a progressive disease which decreases lung capacity and can cause increased susceptibility to tuberculosis. Appropriate respiratory equipment is a must when sandblasting.

Minimizing Health Hazards

There are several ways to control or minimize employee exposure to hazardous substances or conditions. These control methods can be used alone or in combination with others:

1. Substitute a less harmful material for one which is dangerous to health.
2. Alter a process to minimize worker exposure.
3. Isolate or enclose a work operation to reduce the number of workers exposed.
4. Wet method reduces the generation of dust.

5. Local exhaust at the point of generation of contamination.
6. General or dilution exhaust ventilation with clean air to provide a safe atmosphere.
7. Personal protective equipment such as special clothing, respirators, gloves, glasses, etc.
8. Good housekeeping and good personal hygiene.
9. Administrative controls such as reducing exposure time, rotating jobs, etc.
10. Training and education to supplement control methods and satisfy hazard communication regulations.

As with all industries, the ultimate job of safety comes down to each individual. Proper management is the key. If unsafe acts and conditions are allowed to exist, then they will exist. Hazardous work and materials must be constantly monitored to assure that each person performs their job properly and safely. Training and education are also very important. In order to determine hazardous conditions, an employee must know why the condition may be hazardous. Supervisors need to work like a coach to bring employees together to work as a team.

Section II: Project Planning

Page 22 Project plan outline

Page 23 Shop drawing of field exercises

Pages 24-25 *Planning Is The Key To Building More Efficiently*

Trainee Section Objectives

1. To become aware of the importance of project planning and to demonstrate this awareness during field exercises and on construction projects.

Project Plan Outline

Project Plan:

1. Site inspection
   a. take measurements
   b. make a rough sketch of area
   c. make notes on site preparation, material storage, etc.

2. Shop drawings
   a. review scale drawing of area
   b. add class projects to drawing
   c. add all needed dimensions to drawing

3. Construction plan
   a. material storage
   b. location of mixer
   c. scaffolding
   d. tending mason
   e. housekeeping
   f. size of crew
   g. size and type of equipment

Shop Drawing of Project Area

Drawing to contain all existing structures in solid lines. Proposed projects drawn in using dashed lines.

Planning is the key to building more efficiently

by: Joseph R. Proctor, Jr.
Construction Consultant
Lake Oswego, Oregon

Shop drawings aren't provided on time. Construction materials arrive out of sequence or late. Cranes on the job have inadequate capacity or reach. Precast concrete arrives at the jobsite, but correct chokers and slings needed for unloading it aren't available. All these problems have the same effect - a slip in construction efficiency and productivity. But concentrating on the effect gives too little attention to the cause of the problems-not enough emphasis on planning.

Without good planning, efficiency in construction can't be achieved. One reason for this is a constantly changing work force. Except for contractors who work only in their own area, most general contractors acquire a new work force on each project. Only project managers and key superintendents move from job to job. Providing these key people with a well-thought-out plan will help them get the new supervisors, including foremen, up to speed quickly.

Develop plans in detail

Planning requires more than just feeding scheduling data into a computer program. Good old-fashioned hands-on planning requires a close look at each construction operation. At the start of every project-preferably when the estimate or proposal is made-develop a detailed, realistic plan for building the project. Don't use the backward approach of unit-pricing the quantities of work, then after the contract award, figuring out how to build the job. Having a construction plan early in the game doesn't rule out making changes once the project starts. But it does help you compare and evaluate construction options. There's more to a plan than just selecting major equipment and construction methods. The plan should cover activities such as:

- Sequence of construction of various parts of the project
- Temporary facilities such as shoring, cofferdams, and trestles
- Access for delivery of materials and positioning of erection equipment
- Provisions for and distribution of electricity, water, fuel, and compressed air
- Communications, such as telephones, radios, or pagers
- How the materials are manufactured: The aggregate plant, concrete mixing or batching plant, prefabrication or preassembly of components, and shops for making ducts, piping, weldments, and formwork for concrete
- Offices, shops, storage areas, and warehouses
- Movement of personnel and materials
- Removal of debris
- Cold or hot weather protection provisions

Each activity can affect the other, and each needs to be considered in the written plan. For instance, a man-lift on the outside of a high-rise can delay the installation of exterior panels or facing. Locating the man-lift to reduce this problem takes planning. Preparing a plan for erecting precast concrete should include when to acquire chokers, slings, blocking, and shims, and it should describe how to install inserts for attaching the precast elements to the structure. Make an outline of the plan on paper with as much written description as possible to reduce misinterpretation. Then send the preliminary draft to the supervisory team for its critique and suggestions.

Supervisors need to be knowledgeable

The size and complexity of a project determines how detailed a plan should be. But most important in getting such a plan off the ground is making sure it's understood by superintendents and the foreman. Without good leadership the job won't be done well. Construction supervisors (including superintendents, onsite project managers, and general foremen) should have the following qualities:

Job knowledge - Knowledge of the job requires endless hours studying the plans and specifications. The 8-hour day the craftsman works is not for the dedicated and effective superintendent. He or she can't gain a thorough understanding of the project during the working day when the crews need organizing and managing.

Industry knowledge - It's surprising how uninformed many construction supervisors are of new methods and materials in use in the industry. They must read various trade publications, visit other projects (preferably of the competition), and exchange ideas with other construction people.

Job Contact and Communication - Construction has a changing mix of work activities and requires close and perceptive supervision. This cannot be done from a desk in front of a computer. Supervisors need to verify the quality of the work, assure that workers adhere to the schedule and construction plan, and resolve problems. Even the project manager needs to be walking the job once or twice a day. The conductor of an orchestra doesn't just start the music with a few baton strokes and then take a seat in the first row and listen to the music.

How to control subcontractors and suppliers

To keep the job on schedule, the subcontractors and suppliers must know what is expected of them, and they must be tied to the schedule by the terms of their contracts or purchase orders.

Manufacturers prefer to run out orders and ship them immediately. They also like to manufacture projects of one size all together before producing another size. Contractors must determine the schedule and sequence of shipments and obtain commitment from the supplier to adhere to this plan. If the supplier requires that you accept a full shipment at once, you must be prepared to provide storage and handling or compel the supplier to store the material and deliver to the job as needed.

Subcontractors also have preferences as to how they wish to perform their work. These preferences may not be consistent with the project's plan though. If, for instance, parts of the subcontracted work have to be delayed because of access problems, this should be explained before awarding the subcontract and established as one of the conditions.

It's best for the detailed construction plan to be ready at the time subcontracts are negotiated so that all factors can be considered. Subcontractors also should be informed at this time as to what facilities will be provided or made available to them. You may need to provide for storage, potable water, heat, weather protection, power, debris removal, and material handling equipment.

Prejob and weekly meetings keep job on track

The best way to let everyone know what's expected is to hold a prejob meeting with subs, suppliers, and supervisory staff. This lets each person discuss his or her needs and concerns. Before committing to an expensive form, for instance, a concrete forming sub needs to know if a plumber or electrical sub must penetrate the forms.

Holding meetings once a week during the job is also a good idea. That way any needed changes to the plan can be incorporated easily because everyone will be aware of them. All subs active on the project or due to start shortly should attend the meetings. On an efficiently run job, the supervisory staff controls activities of the subs as though they are part of the general contracting team.

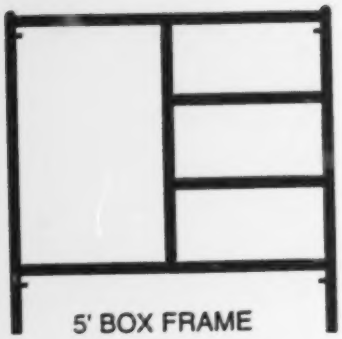
Although no amount of study or planning covers everything, the planning effort is never wasted. Nothing contributes more to a cost-effective job than the onsite presence of knowledgeable and prepared supervisors. And nothing contributes more to supervisor preparation than a detailed, written plan of how the project should be built.

Section III: Scaffold Erection

Page	28	Figure 3-1 depicting scaffold parts
Page	29	Terms and Definitions
Pages	30 - 33	Federal Register Subpart L concerning ladders and scaffolding
Pages	34 - 37	Basic Scaffold Building
Page	38	Job Sheet for Field Exercise 1
Page	39	Job Sheet for Field Exercise 2
Pages	40 - 43	*Do's and Don'ts For Scaffold Building*

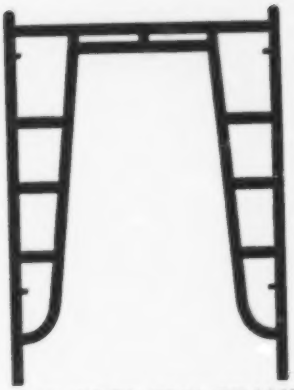
Trainee Section Objectives

1. To learn the following scaffolding terms:
   a. Scaffold Frames
   b. Base Plates
   c. Mud Sills
   d. Screw Jacks
   e. Planking
   f. Guardrail Post
   g. Cross Braces
   h. Outriggers/Side Brackets
   i. Safety Pins
   j. Coupling Pins
   k. Lander
   l. Plumb & Level
2. To correctly describe the first procedure on erecting a safe and secure scaffold.
3. To correctly describe the three most important safety aspects of safe and secure scaffold.
4. To correctly describe the procedure of preparing a safe material landing platform.
5. To describe some of the causes of scaffold collapse.
6. To correctly describe the proper and safe procedure to dismantle a scaffold.
7. To safely and competently prepare surface and erect scaffold at inside and outside wall.
8. To safely and competently dismantle and store scaffold.

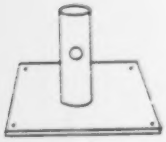


5' BOX FRAME

SCREWJACK

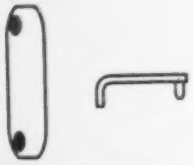


6' 6" OPEN END FRAME

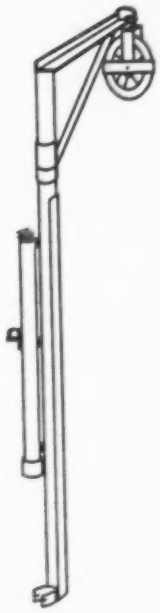


BASE PLATE

CROSS BRACE



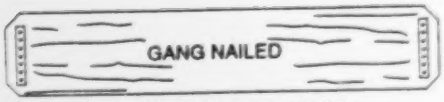
CONNECTING PIN
AND TOGGLE PIN



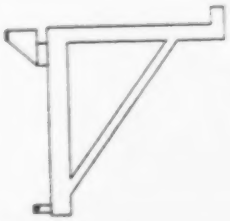
STANDARD HOIST
AND PULLEY

GUARD POST

GUARD RAIL



SCAFFOLD PLANK
2"x 10"x 8'
2"x 10"x 12'
2"x 10"x 16'



SIDE BRACKETS/OUTRIGGERS

Figure 3-1
Basic Scaffold Parts.

Terms and Definitions

Base Plates	Square metal plates with a protruding hollow metal pipe-like section that a screwjack or scaffold leg will slip into.
Coupling Pins	Made of hollow tubular steel. Are used to allow sections of scaffold frames to be stacked together.
Cross Braces	Are used to secure the scaffold horizontally (side to side). Usually found in tubular form, but also in angle form.
Guard Rails	Items consisting of: 1) hollow metal posts that slip over the scaffold coupling pins, 2) angle iron or tubular rails that are attached to the guardrail posts and run horizontally along the scaffold platform. Toe boards should be a minimum of 4" high. The toe board's purpose is to keep material and rubble from falling off the scaffold platform and causing injury to anyone working below.
Lander	A term meaning a temporary platform built right on, or alongside a scaffold on which to place materials needed to replenish what has been used up.
Mud Sill	Square, wooden, minimum 1'x1'x1" pieces, usually of plywood used to support scaffold. Other types of lumber may be used provided it is standard grade lumber, i.e. 2"x12"x1'.
Masonry Scaffold Frames/Jacks	Tubular steel frames usually with a ladder configuration at one end, that when cross braced together provide a strong and stable temporary structure.
Outriggers/ Side Brackets	Made of angular steel or tubular design. Are used to increase the work area of the scaffold. They are very essential when working with the mason.
Planks	Wooden 2"x12"x16' or 2"x12"x8' scaffold grade lumber or laminated lumber used to provide a temporary platform on the scaffolding so material can be stacked and so the mason may walk on.
Plumb and Level	Means that to have a safe and secure scaffold it should be plumb (straight up and down), and level (straight horizontally) to assure that it does not lean in any direction and that the cross braces will go on easier when additional scaffold is added on.
Safety Pins	Either of hinge design or a plain connecting pin with a cotter pin. Is used to lock each leg of one scaffold to the coupling pin of another scaffold when stacking two scaffold jacks/frames together.
Screw Jacks	A threaded piece of metal with a wingnut that can be screwed up or down to adjust the height of a scaffold, in order for the scaffold to be plumb and level.

Federal Register
Subpart L - Ladders and Scaffolding

1926.450 Ladders

(a) General requirements. (1) Except where either permanent or temporary stairways or suitable ramps or runways are provided, ladders described in this subpart shall be used to give safe access to all elevations.

(2) The use of ladders with broken or missing rungs or steps, broken or split side rails, or other faulty or defective construction is prohibited. When ladders with such defects are discovered, they shall be immediately withdrawn from service. Inspection of metal ladders shall include checking for corrosion of interiors of open end hollow rungs.

(3) Manufactured portable wood ladders provided by the employer shall be in accordance with the provisions of the American National Standards Institute, A 14.1-1968, Safety Code for Portable Wood Ladders.

(4) Portable metal ladders shall be of strength equivalent to that of wood ladders. Manufactured portable metal ladders provided by the employer shall be in accordance with the provisions of the American National Standards Institute, A 14.2-1956, Safety Code for Portable Metal Ladders.

(5) Fixed ladders shall be in accordance with the provisions of the American National Standards Institute, A 14.3-1956, Safety Code for Fixed Ladders.

(6) Portable ladder feet shall be placed on a substantial base, and the area around the top and bottom of the ladder shall be kept clear.

(7) Portable ladders shall be used at such a pitch that the horizontal distance from the top support to the foot of the ladder is about one-quarter of the working length of the ladder (the length along the ladder between the foot and the top support). Ladders shall not be used in a horizontal position as platforms, runways, or scaffolds.

(8) Ladders shall not be placed in passageways, doorways, driveways, or any location where they may be displaced by activities being conducted on any other work, unless protected by barricades or guards.

(9) The side rails shall extend not less than 36 inches above the landing. When this is not practical, grab rails, which provide a secure grip for an employee moving to or from the point of access, shall be installed.

(10) Portable ladders in use shall be tied, blocked, or otherwise secured to prevent their being displaced.

(11) Portable metal ladders shall not be used for electrical work or where they may contact electrical conductors.

(b) Job-made ladders. (1) Job-made ladders shall be constructed for intended use. If a ladder is to provide the only means of access or exit from a working area for 25 or more employees, or simultaneous two-way traffic is expected, a double cleat ladder shall be installed.

(2) Double cleat ladders shall not exceed 24 feet in length.

(3) Single cleat ladders shall not exceed 30 feet in length between supports (base and top landing). If ladders are to connect different landings, or if the length required exceeds this maximum length, two or more separate ladders shall be used, offset with a platform between each ladder. Guardrails and toe-boards shall be erected on the exposed sides of the platforms. (See 1926.451 (a)(5).)

(4) The width of single cleat ladders shall be at least 15 inches, but not more than 20 inches, between rails at the top.

(5) Side rails shall be parallel or flared top to bottom by not more than one-quarter of an inch for each 2 feet of length.

(6) Wood side rails of ladders having cleats shall not be less than $1\frac{1}{2}$ inches thick and $3\frac{1}{2}$ inches deep (2 inches by 4 inches nominal) when made of Group 2 or Group 3 woods (see Table L-1). Wood side rails of Group 4 woods (see Table L-1) may be used in the same cross-section of dimensions for cleat ladders up to 20 feet in length.

(7) It is preferable that side rails be continuous. If splicing is necessary to attain the required length, however, the splice must develop the full strength of a continuous side rail of the same length.

(8) 2-in by 4-inch lumber shall be used for side rails of single clear ladders up to 16 feet long; 3-inch by 6-inch lumber shall be used for single cleat ladders from 16 to 30 feet in length.

(9) 2-inch by 4-inch lumber shall be used for side and middle rails of double cleat ladders up to 12 feet in length; 2-inch by 6-inch lumber for double cleat ladders from 12 to 24 feet in length.

(10) Wood cleats shall have the following minimum dimensions when made of Group 1 woods (see Table L-1):

Table L-1-Average Densities of Various Species of Wood for Use in Ladders

Group 1		Group 2	
Species	Density (lbs/ft)	Species	Density (lbs/ft)
White ash	41	Douglas fir (coast region)	34
Beech	43	Western larch	38
Birch	44	Southern yellow pine	37
Rock elm	43		
Hickory	50		
Locust	47		
Hard maple	42		
Red maple	36		
Red oak	43		
White oak	46		
Pecan	46		
Persimmon	50		
Group 3		**Group 4**	
Red alder	28	Aspen	27
Oregon ash	38	Basswood	25
Pumpkin ash	37	Buckeye	25
Alaska cedar	31	Butternut	27
Port orford cedar	30	Incense cedar	25
Cucumber	34	Western red cedar	23
Cypress	32	Black cottonwood	24
Soft elm	36	White fir	26
Douglas fir (Rocky Mt. type)	30	Hackberry	37
Noble fir	27	Eastern hemlock	28
Gum	34	Holly	39
West Coast hemlock	30	Soft maple	33
Magnolia	35	Lodgepole pine	29
Oregon maple	34	Idaho white pine	28
Norway pine	31	Northern white pine	25
Poplar	28	Ponderosa pine	28
Redwood	25	Sugar pine	26
Eastern spruce	28		
Silka spruce	28		
Sycamore	35		
Tamarack	37		
Tupelo	35		

(11) Cleats may be made of species of any other group of wood (see Table L-2) provided equal or greater strength is maintained.

Table L-2-Wood cleat dimensions when constructed with Group 1 wood.

Length of cleat (inches)	Thickness (inches)	Width (inches)
Up to and including 20	3/4	3
Over 20 and up to and including 30	3/4	3 3/4

(12) Cleats shall be inset into the edges of the side rails one-half inch, or filler blocks shall be used on the rails between the cleats. The cleats shall be secured to each rail with three 10d common wire nails or other fasteners of equivalent strength. Cleats shall be uniformly spaced, 12 inches top-to-top.

1926.451 Scaffolding.

(a) General requirements. (1) Scaffolds shall be erected in accordance with requirements of this section.

(2) The footing or anchorage for scaffolds shall be sound, rigid, and capable of carrying the maximum intended load without settling or displacement. Unstable objects such as barrels, boxes, loose brick, or concrete blocks, shall not be used to support scaffolds or planks.

(3) No scaffold shall be erected, moved, dismantled, or altered except under the supervision of competent persons.

(4) Guardrails and toeboards shall be installed on all open sides and ends of platforms more than 10 feet above the ground or floor, except needle beam scaffolds and floats (see paragraphs (p) and (w) of this section). Scaffolds 4 feet to 10 feet in height, having a minimum horizontal dimension in either direction of less than 45 inches, shall have standard guardrails installed on all open sides and ends of the platform.

(5) Guardrails shall be 2x4 inches, or the equivalent, approximately 42 inches high, with a midrail, when required. Supports shall be at intervals not to exceed 8 feet. Toeboards shall be a minimum of 4 inches in height.

(6) Where persons are required to work or pass under the scaffold, scaffolds shall be provided with a screen between the toeboard and the guardrail, extending along the entire opening, consisting of No. 18 gauge U.S. Standard wire 1/2-inch mesh, or the equivalent.

(7) Scaffolds and their components shall be capable of supporting without failure at least 4 times the maximum intended load.

(8) Any scaffold, including accessories such as braces, brackets, trusses, screw legs, ladders, etc. damaged or weakened from any cause shall be immediately repaired or replaced.

(9) All load-carrying timber members of scaffold framing shall be a minimum of 1,500 fiber (Stress Grade) construction grade lumber. All dimensions are nominal sizes as provided in the American Lumber Standards, except that where rough sizes are noted, only rough or undressed lumber of the size specified will satisfy minimum requirements.

(10) All planking shall be Scaffold Grades, or equivalent, as recognized by approved grading rules for the species of wood used. The maximum permissible spans for 2- x 10-inch or wider planks shall be as shown in table L-3.

Table L-3 Material

	Full Thickness Undressed Lumber			Nominal Thickness Lumber*	
Working load (p.s.f)	25	50	75	25	50
Permissible span (ft.)	10	8	6	8	6

* Nominal thickness lumber not recommended for heavy duty use.

(11) The maximum permissible span for 1 1/4- x 9-inch or wider plank of full thickness shall be 4 feet with medium duty loading of 50 p.s.f.

(12) All planking of platforms shall be overlapped (minimum 12 inches), or secured from movement.

(13) An access ladder or equivalent safe access shall be provided.

(14) Scaffold planks shall extend over their end supports not less than 6 inches nor more than 12 inches.
(15) The poles, legs, or uprights of scaffolds shall be plumb, and securely and rigidly braced to prevent swaying and displacement.
(16) Overhead protection shall be provided for men on a scaffold exposed to overhead hazards.
(17) Slippery conditions on scaffolds shall be eliminated as soon as possible after they occur.
(18) No welding, burning, riveting, or open flame work shall be performed on any staging suspended by means of fiber or synthetic rope. Only treated or protected fiber or synthetic ropes shall be used for or near any work involving the use of corrosive substances or chemicals. Specific requirements for boatswain's chairs and float or ship scaffolds are contained in paragraphs (l) and (w) of this section.
(19) Wire, synthetic, or fiber rope used for scaffold suspension shall be capable of supporting at least six times the rated load.
(20) The use of shore or lean-to scaffolds is prohibited.
(21) Lumber sizes, when used in this subpart, refer to nominal sizes except where otherwise stated.
(d) Tubular welded frame scaffolds. (1) Metal tubular frame scaffolds, including accessories such as braces, brackets, trusses, screw legs, ladders, etc., shall be designed, constructed, and erected to safely support four times the maximum rated load.
(2) Spacing of panels or frames shall be consistent with the loads imposed.
(3) Scaffolds shall be properly braced by cross bracing or diagonal braces, or both, for securing vertical members together laterally, and the cross braces shall be of such length as will automatically square, and aline vertical members, so that the erected scaffold is always plumb, square and rigid. All brace connections shall be made secure.
(4) Scaffold legs shall be set on adjustable bases or plain bases placed on mud sills or other foundations adequate to support the maximum rated load.
(5) The frames shall be placed one on top of the other with coupling or stacking pins to provide proper vertical alinement of the legs.
(6) Where uplift may occur, panels shall be locked together vertically by pins or other equivalent suitable means.
(7) To prevent movement, the scaffold shall be secured to the building or structure at intervals not to exceed 30 feet horizontally and 26 feet vertically.
(8) Maximum permissible spans for planking shall be in conformity with paragraph (a)(10) of this section.
(9) Drawings and specifications for all frame scaffolds over 125 feet in height above the base plates shall be designed by a registered professional engineer.
(10) Guardrails made of lumber, not less than 2x4 inches (or other material providing equivalent protection), and approximately 42 inches high, with a midrail of 1x6 inch lumber (or other material providing equivalent protection), and toeboards, shall be installed at all open sides and ends on all scaffolds more than 10 feet above the ground or floor. Toeboards shall be a minimum of 4 inches in height. Wire mesh shall be installed in accordance with paragraph (a)(6) of this section.

Scaffold Erection and Dismantling

The base of a scaffold is very important. The legs should be set on a solid base, such as a large heavy board or plank called a mud sill. If not, the weight of the scaffold, men, and material placed on the scaffold will cause them to sink into the ground. This is not necessary when the scaffold is built on a concrete floor. Figure 3-2 depicts a standard mud sill layout for a straight section. Note the standard layout dimensions in Figure 3-2, such as the distance from end of frame to end of frame, the distance from end of mud sill to end of mud sill, and the placement of the mud sill away from the masonry wall.

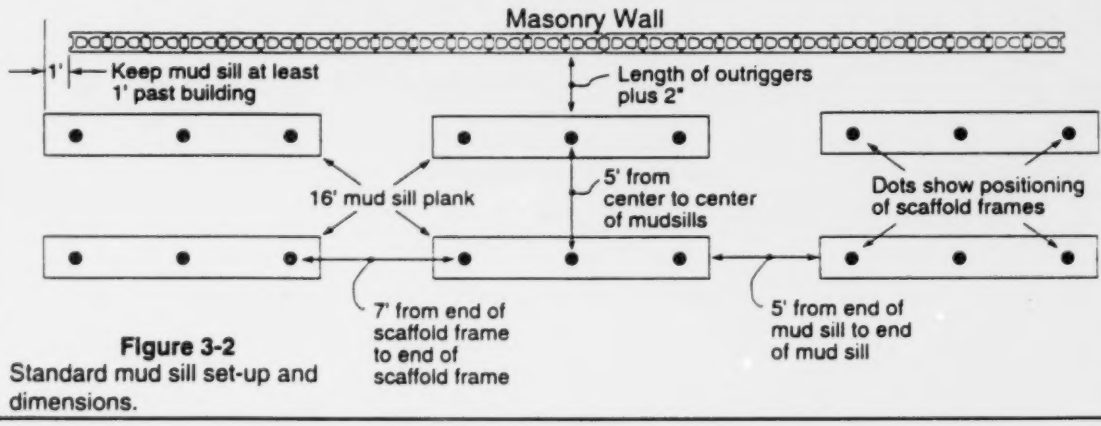

Masonry Wall
1'
Keep mud sill at least 1' past building
Length of outriggers plus 2"
16' mud sill plank
5' from center to center of mudsills
Dots show positioning of scaffold frames
7' from end of scaffold frame to end of scaffold frame
5' from end of mud sill to end of mud sill

Figure 3-2
Standard mud sill set-up and dimensions.

Placing the mud sills

Mark the center line of the mud sill. This can be accomplished quickly by holding an outrigger close to the masonry wall and using the bottom of the outrigger to scribe a line in the grade as you walk along the wall. Grade a shovel width on each side of the line to make a compact and uniform base for the mud sill. Measure five feet over and grade for the outside sill. Place both sills and check for voids or humps under them.

Assembling the frames

Once you have a pair of mud sills in place, stand a frame up on the base plates and attach a cross brace on the outside to keep the frame upright. Stand the next frame on base plates and attach the cross brace, **bottom first**. Adjust the frame distance from the masonry wall by setting the outriggers in place and checking for a 2" clearance from outrigger to wall.

Use shims to level the first frame, or if you are using screw jacks for base plates, adjust them to set the first frame level. Level across the frame and use a straight 2x4 or plank as a straight edge to level lengthwise along the frame. Having each frame level and plumb is extremely important. If you assemble frames that are not level, the upper layers or other frames in line will not fit correctly.

Repeat the procedure for the third and all remaining frames, double checking plumb, level, and distance from wall to outriggers as you continue.

Once you have at least three frames assembled, leveled, and plumbed, you can use the technique called "sweding" (pronounced sweeding) to make quick double checks on the frames for alignment, level, and plumb. Use this technique by standing away from the frames and sighting in line with the three previous frames and looking for deviation of the following frames. Figure 3-3 depicts a starting layout with three frames assembled.

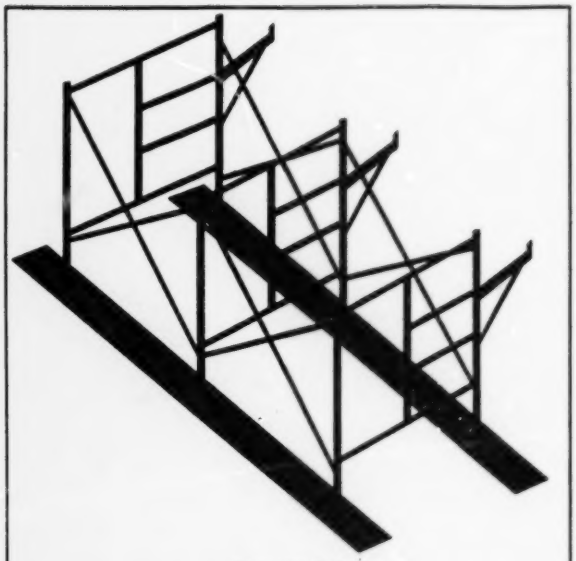


Figure 3-3
Pictorial view of three frames assembled

Plank placement

Before placing a plank on the scaffold it should be inspected to insure it will bear the weight of the men and material and does not contain nails or other hazards. Planks that are broken or have large knots or any other defect should not be used.

Planks on scaffold frames should be overlapped 12" so they won't slip off. They should hang over the end of the frame between 6" and 12" so they will not flip off if someone stands on them. A worker looking at planks overhanging further than 12" will not realize that there is no support underneath the end of them. Such carelessness can cause serious injury or death in the case of high scaffolds. Figure 3-4 depicts an overhead view of a standard plank and mud sill placement. Note how the foot planks and material planks are numbered.

Whenever setting plank or adjusting foot plank height, do not set the planks higher than the top of the wall. This would force the bricklayers to bend too far to place the masonry units.

Before allowing the mason to work on the finished scaffold, always check out the entire area yourself, especially the walking plank.

Inspect the scaffold for the following common causes of scaffold collapse or failure:

- not being properly cross braced
- over loading
- poor soil conditions or inadequate foundation
- not having the frames plumb and level
- not being secured

Don't build a trap for men to work on. Continually inspect scaffolds for signs of danger. If they start to lean or sag, immediately do an inspection to find the cause of the movement.

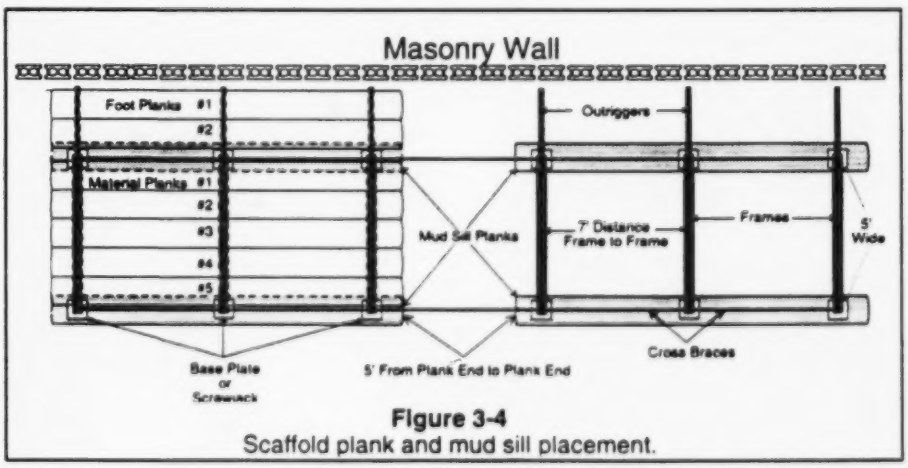


Figure 3-4
Scaffold plank and mud sill placement.

Securing the Scaffold

Federal Regulations specifically state that to prevent movement, a scaffold shall be secured (tied off) to the building or structure. Most regulations require the scaffold to be secured every 26' vertically and every 30' horizontally, but these distances do vary depending on other factors. Be sure to check the regulations that apply.

Scaffolds should be tied off more frequently when they are enclosed, and subjected to various wind speeds.

Because of today's changing scaffold designs there are various ways to secure scaffolds. Figure 3-5 shows three possible methods of tieing off scaffolds:

1) Using No. 9 wire, 2x4 spreader, 4x4 on inside of structure, on other side of opening.

2) Using No. 9 wire, 2x4 spreader, wire secured to rebar at bed joint.

3) Using No. 9 wire, 2x4 spreader, wire attached to eyelet pin embedded in wall.

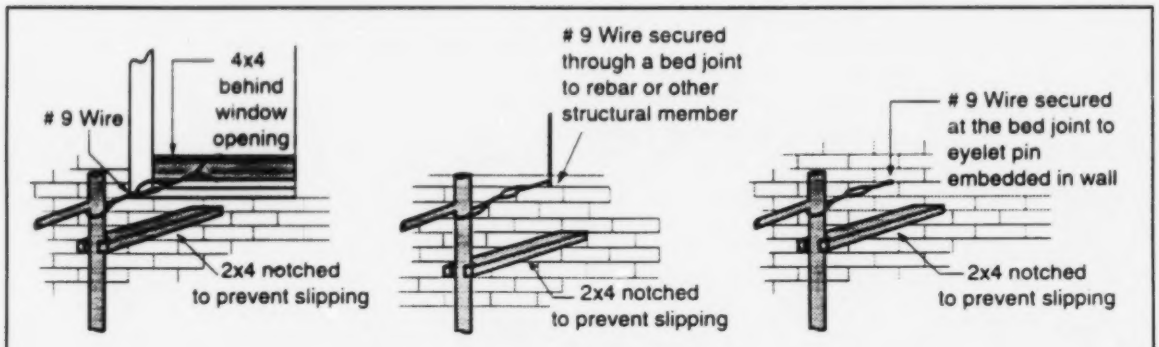

9 Wire
4x4 behind window opening
2x4 notched to prevent slipping
9 Wire secured through a bed joint to rebar or other structural member
2x4 notched to prevent slipping
9 Wire secured at the bed joint to eyelet pin embedded in wall
2x4 notched to prevent slipping

Figure 3-5
Methods to secure a scaffold to a building.

In all situations, it is important to secure to a good, solid section of building. Each example in Figure 3-5 shows that wooden spreaders exist between the scaffold and the building. These spreaders must be of solid material, free of defects, and V-notched on the scaffold side to prevent the tubing from slipping off the spreaders. The spreaders are used to prevent the scaffold from leaning in, and the wire keeps it from leaning away from the structure.

Dismantling Scaffolds

Dismantling or tearing down a scaffold requires extra safety precautions to be taken.

1) Begin dismantling scaffold by removing extra materials

2) Remove guard rail and guard rail posts and lower to the ground.

3) Planks and toe boards should be stacked on the scaffold frames (never on the outriggers) so the forklift can pick them off. In the event that the scaffold is extremely high a crane may be used to pick the plank off, otherwise the planks have to be relayed down to the next level of scaffold until a forklift can reach and pick them off. (Note: A three plank working platform should be used when dismantling a scaffold.)

4) Remove outriggers and lower to ground.

5) Cross braces are the next item to be removed. A wooden block pallet should be used to stack the cross braces so that the forklift may pick them off. The same procedures used for plank removal should be taken in the event of extreme heights.

6) Safety pins should be removed at this point. A small pail or tempering can may be used to keep these small safety pins so you don't lose them.

7) Scaffold frames are next to be removed. If a forklift is available, and can reach where you are working, start from the middle and work towards the ends. Hang the scaffold frames on the forklift forks and lower down to the ground or transport to the next scaffold erection location. In the event a forklift is not available, scaffold frames must be relayed down or lowered with a rope, or hung on the frame below, then lowered by hand to the ground.

8) At this point one goes down to the next level and repeats the same procedures.

When a wall is finished, tear down the scaffold and use it for other walls that are being built. If it is not needed elsewhere, stack it neatly. Don't use scaffold frames from the stock pile if frames are available from a wall that has been finished.

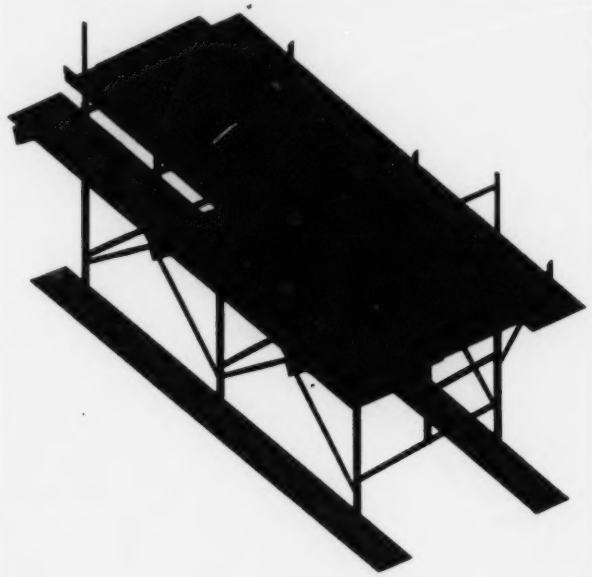


Figure 3-6
Temporary material lander constructed of extra plank and outriggers.

Material Handling

When using a forklift to help build scaffold, always keep all scaffold parts and plank on something that will hold them off of the ground, like a pallet. This will allow the forks to be placed under them without the driver needing to get off his machine to load them on by hand. Use the forklift to your advantage.

When placing materials on the scaffold you can build a temporary landing platform (lander) using outriggers/sidebrackets as shown in Figure 3-6. Be certain that any safety rails removed for landing material are replaced immediately.

SECTION III: JOB SHEET

Exercise #1 - Prepare surface and erect outside corner scaffold as shown in Figure 3-7.

1) Check to make sure you have:

Personal Protective Equipment:

hard hat	gloves	safety glasses

Scaffold Parts:

cross braces	outriggers	scaffold frames	base plates
mud sills	safety pins	screw jacks	9' and 16' scaffold plank

Tools and Materials:

pick	level (torpedo)	hammer	adjustable wrench
side cutter	10' straight edge	tape measure	round & square shovels
No. 9 wire	nails, 16d duplex	belt and tool pouch	

2) Prepare ground surface area by grading and getting the surface as level as possible so the mud sills will set flat and firm on the ground.

3) Place mud sills even with outside corner and space as shown in Fig. 3-2. Scaffold frame should be placed no more than 1 foot in from outside corner. If screw jacks are to be used they may be inserted into the base plates. Place the scaffold frames over the screw jacks and attach one cross brace to keep the frame upright. Repeat the procedure at the end of the cross brace and brace the two frames together.

4) Using the level, begin by plumbing the back legs of the scaffold (up and down). Once you have both back legs plumb, place an 8' plank or a straight 2"x4"x8' on top of the scaffold. Place the level horizontally on the plank or 2"x4" and adjust the screw jacks, checking to see if scaffold is plumb, until both frames are level with each other. Install the other cross brace and repeat the procedure on down the line. Once you have reached the corner of the wall go on past by using an extra frame. Start in the next direction repeating the previous procedures.

5) Place the 16' plank on the scaffold to create your platform. It should take 5 planks on top of the scaffold and 2 on the outrigger every three frames. The first plank on the scaffold nearest the wall should be at least 4" back from the coupling pin to allow the outrigger to hang at the top of the scaffold frame. By using a 16' plank you should have a 1' lap at each end of the scaffold frames.

6) Install guard rails once you reach ten feet in height.

7) Nail base plate into mud sills to keep scaffold secure.

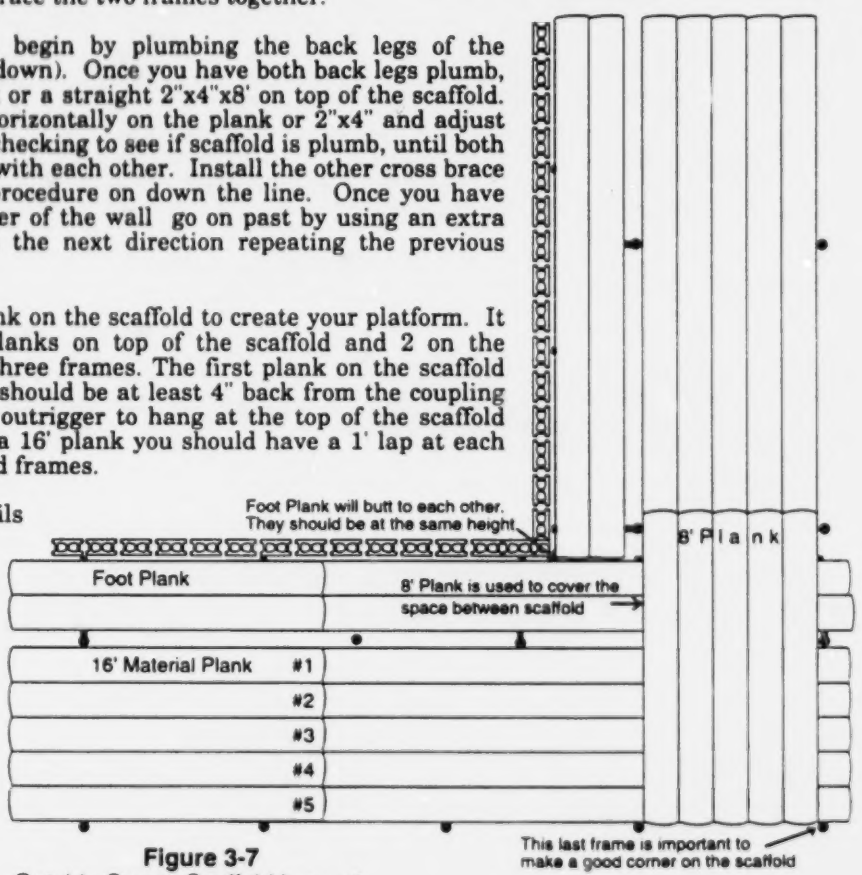

Foot Plank will butt to each other. They should be at the same height
8' Plank
Foot Plank
8' Plank is used to cover the space between scaffold
16' Material Plank
#1
#2
#3
#4
#5
This last frame is important to make a good corner on the scaffold

Figure 3-7
Outside Corner Scaffold Lay-out.

SECTION III: JOB SHEET

Exercise #2 - Prepare surface and erect inside corner scaffold as shown in Figure 3-8.

1) Using an outrigger, mark the distance from both walls allowing 2" between outrigger and the wall (swing outrigger in 90° arc).

2) Prepare ground surface as in exercise #1 and place mud sills. Back mud sill should be 5' on center from front mud sill.

3) Distribute scaffold parts and set base plates on mud sill.

4) Begin scaffold erection with two frames and one cross brace along north-south wall.

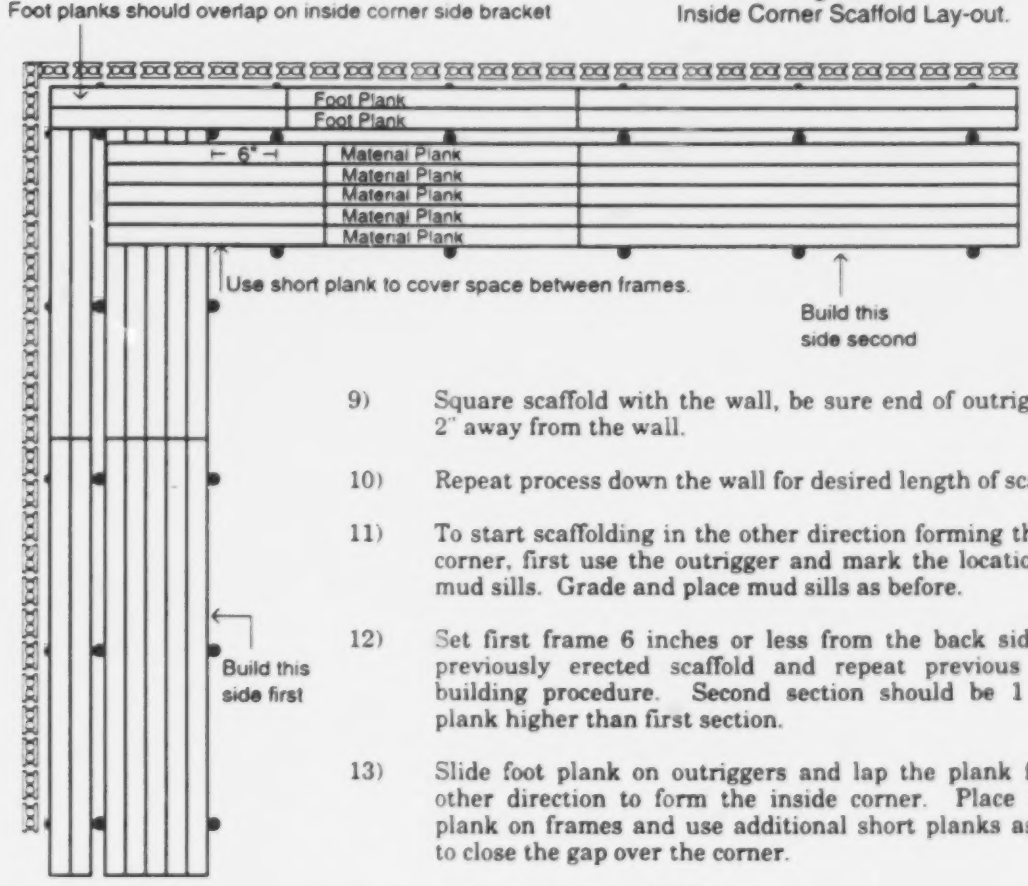
5) Attach outriggers at desired height.

6) Raise front leg to desired height, then raise back leg to level the frame. Repeat process with second frame, attach second cross brace.

7) Attach next cross brace and third frame and level as previously done, next attach back cross brace.

8) At this time, put on both foot planks and 5 material planks, keep first material plank far enough back to allow for raising of outrigger (approximately 4-finger width).

Figure 3-8
Inside Corner Scaffold Lay-out.



9) Square scaffold with the wall, be sure end of outriggers are 2" away from the wall.

10) Repeat process down the wall for desired length of scaffold.

11) To start scaffolding in the other direction forming the inside corner, first use the outrigger and mark the location of the mud sills. Grade and place mud sills as before.

12) Set first frame 6 inches or less from the back side of the previously erected scaffold and repeat previous scaffold building procedure. Second section should be 1 scaffold plank higher than first section.

13) Slide foot plank on outriggers and lap the plank from the other direction to form the inside corner. Place material plank on frames and use additional short planks as needed to close the gap over the corner.

Scaffolding Do's and Don'ts
Safety Tips for Erecting and Using Frame Scaffold

By Geoff Mules
GM Scaffolding Consultants
Pasadena, Texas

Nowhere is safe scaffolding more important than in the masonry industry. The heavy, concentrated loads imposed by pallets of brick and block continually test the strength of scaffolding. Despite this well-known fact, all too often scaffolds are constructed on poor foundations with insufficient cross bracing, no guardrails, dangerous planking, and no ties to the building structure. All these practices lead to accidents - accidents that happen because people take shortcuts, forget, get lazy, or never learn the correct way to erect or use scaffolds. With a well-constructed scaffold, masons can concentrate on laying brick rather than staying alive. On the bottom line, this means they can lay more brick.

Scaffold erectors should be trained

Over the last decade Europe has rapidly begun to regard scaffold building as a separate trade. To erect scaffolding a person must be trained and have a certificate or license that shows competency. Training courses in England last up to one year.

Formal training of scaffold erectors is not widely available in the United States. Skills tend to be learned through hands-on experience. To avoid accidents and accident-related costs, sophisticated masonry contractors train certain key personnel how to erect the scaffold or hire a competent specialty scaffold subcontractor to erect it for them.

When properly erected, welded steel frame scaffolding is rigid, safe, and strong enough to carry heavy masonry materials. Suitable for both large and small projects, it is the most common scaffold system used by masons in the United States today. But it must be erected and used correctly. Here are some scaffolding **do's** and *don'ts*.

Getting Ready

DO

Inspect the equipment. Make sure all scaffold components are sound. Look for damaged welds, dents, and crooked or bent members. Check that all locking devices operate freely. If possible, inspect all materials before they are transported to the jobsite. Any equipment that is not in good working order should be rejected and tagged for repair.

Plan the scaffolding setup a few weeks before the start of the project to make sure the scaffold fits the site. Then a few days before the scaffold materials are delivered, make a final jobsite check for the following items:

- A staging area is available.
- The ground is level and stable.
- The original scaffold layout is still feasible.
- The scaffold does not need to be designed by an engineer. (The Occupational Safety and Health Administration [OSHA] requires that scaffolds over 125 feet high be designed by a licensed professional engineer. An engineer's approval of lower scaffolds is also wise, especially if the scaffold is heavily loaded.)
- Access to the site allows easy and safe delivery of scaffold materials.
- Overhead power lines are not present.
- Other hazards, such as excavations, are not present.
- Scaffolding complies with federal and local building codes.
- A forklift or crane is available to move the scaffolding.
- There are enough sound scaffolding materials to complete the first phase of the project.

Provide a stable base. Firm, level, undisturbed soil, properly compacted aggregate, or concrete thick enough to carry imposed loads are the best supports for the base of a scaffold. Backfilled, water-bearing, or frozen soil should be tested by the site engineer to determine if it has adequate bearing capacity. Soil that cannot support the

proposed loads can cause a scaffold failure in a short time. Compact all backfill, even a small area of backfill. Differential settlement of the bases can concentrate stress in one area of the scaffold, resulting in damage and possibly failure of that section of the scaffold. Therefore, every area of the bearing surface should be able to support the maximum intended load on that area.

DON'T
Mix scaffold frames and parts made by different manufacturers. Frames from one manufacturer normally are not compatible with frames from another.

DON'T
Skimp on scaffold accessories and construct a scaffold that is structurally incomplete and unsafe. (Masonry contractors who own their own scaffolding materials should not try to cut costs by using fewer parts.)

Erecting the frames

DO

Follow the manufacturer's recommended erection procedures. Rented scaffolding often comes with these procedures printed on the back of the rental agreement. Erection procedures and scaffold capacities do vary.

Use at least three workers to assemble the scaffold: two on the scaffold, connecting parts, and one passing up parts. Two workers can do the job but not as safely and efficiently.

Use mud sills under the scaffold legs to distribute the concentrated leg loads over a greater area, unless the scaffold is erected on a paved or solid base. Nail the base plates to the mud sills.

Use adjustable screw jacks with fixed base plates. They allow the base of the scaffold to follow the natural contours of soil while the scaffold frame itself is erected plumb and level.

Join the frames with cross braces. The cross braces hold the frames in place and ensure that subsequent levels are true and plumb. After the cross braces are in place, make sure the screw jacks are still bearing weight. Sometimes a cross brace will lift a frame off the jacks.

DO

Install locking devices, such as toggle pins, in the connecting pins to prevent the scaffold from separating at the vertical joints.

Level the first tier of scaffold first, before erecting the remaining tiers. Adjust the screw jacks as necessary. If the first tier is out of plumb by only 2 inches, the fifth tier will be out of plumb by 10 inches or more.

Lay out the scaffold and side brackets so the planking is within a few inches of the wall, making it impossible for a worker to fall through the gap between the planking and the wall. When installed, side brackets should parallel the scaffold frames and end brackets should be perpendicular to the frames.

Pass scaffold parts up with a rope, not with an unsafe reach. A block and tackle allows the hoisting to be done by a worker on the ground, which eliminates the risk of workers falling from the scaffold as they pull materials up by rope.

DON'T
Omit cross braces. Although all cross braces are not always needed, it takes a well-trained scaffold designer to know when and where some of them can be omitted. The safest and simplest practice is to always install all cross braces.

DON'T
Block up bases with blocks, bricks, or lumber. Vibrations often move a leg off this type of support. The weight of the scaffold also can cause the brick or block to crack and fall away.

DON'T
Use excessive force to install cross braces. If force is required, then the scaffold is probably not plumb and level.

Installing the planking

DO

Use only planking approved for masonry work: scaffold grade lumber, laminated wood scaffold planks, or steel, aluminum, or aluminum-plywood scaffold planks that are rated for your purpose and have grading or load capacity clearly marked.

Inspect all planking before each use; deterioration and damage can occur rapidly, especially from heavy masonry loads. Don't underestimate the importance of planking: many scaffold accidents happen because of planking failure.

DO

Secure all planks to their supporting brackets. Although this is really only necessary when high winds are present, are you ever certain there won't be high winds? Tie down wood planks and use special locking devices on metal planks. Keep planking tight. Extend wood planking over the horizontal bearing members at least 6 inches but not more than 12 inches. Lap planks over other planks at least 12 inches. On tower scaffolds, fasten a 2x4 cleat to the bottom of each plank so vibrations don't cause the plank to slide off the bearing member.

DON'T

Use nominal 2x10 wood planks. Nominal 2x10's are actually 1 1/2 x 9 1/2 inches, which is not adequate for scaffolds loaded with heavy masonry materials. Planks must be rough cut at least 2x10 inches.

DON'T

Use wood planks with loose or large knots, checks, splits, or prominent sap lines.

DON'T

Paint wood planks. Paint hides defects.

DON'T

Use scaffold planks for mud sills and then reuse them as scaffold planks.

DON'T

Leave the deck partially planked. Space between adjacent planks should not be greater than 1 inch.

Erecting guardrails

DO

Install guardrails and midrails on all work platforms to prevent falls and give workers confidence. Top guardrails should be 36 to 45 inches above the planking.

Use toe boards wherever people must work or pass under the scaffold, so tools and material don't fall from the scaffold. Toe boards should be at least 3 1/2 inches high. When materials are piled higher than the toe board, cover the opening between toe board and top rail with a wire screen. The screen should be a 1 1/2 inch mesh made of #19 gauge wire.

Install the deck and guardrails after erecting the first level of the scaffold, if possible. This will give the scaffold erectors and helpers a larger and safer work platform.

DON'T

Omit the double guardrail barrier at the end of the scaffold deck.

Preventing the scaffold from falling over

DO

Tie the scaffold to the building when the scaffold height is four times the minimum dimension, as required by the American National Standards Institute. Install ties at the height where this occurs and above this height every 26 feet vertically and every 30 feet horizontally. Consider installing ties for even lower scaffolds, and always tie the top lift and both ends of the scaffold to the building structure. If tall scaffolds aren't tied to the building, they will fall over. With materials loaded at the top, their center of gravity becomes too high. Because the scaffold can fall toward or away from the building, the ties must resist both tension and compression. Wire and wood stud ties and tube and clamp ties are two common ties that are used.

Tie the scaffold together at the corners of the building also. Wire ties to the building give the scaffold little horizontal stability.

Check ties regularly and particularly before dismantling the scaffold. Make sure they are properly in place.

Add extra ties in winter when tarps are used to enclose the scaffold. Tarps increase the wind resistance of the scaffold.

Inspection

DO

Check the following items as soon as the scaffold is erected and periodically during use.

- Ground beneath the mud sills has not thawed, eroded, or settled.
- Scaffold bases are not near excavations or holes.
- All screw jack handles are snug against frame legs and each screw jack is bearing weight.
- Scaffold is plumb and level.
- All planking is in place and secure.
- All ties are intact.
- Connecting pins have locking devices in place.
- All guardrails are in place.
- No loose scaffold materials are lying around. If there are, check where they have come from.

Using the scaffold

DO

Provide a ladder or other equivalent safe access to the work platform, as required by OSHA. An internal access stairway can provide safe passage for many workers at the same time. Fixed ladders or frames with built-in ladders are sufficient on low-rise projects.

DON'T

Overload the scaffold. More scaffolding is overloaded in the masonry industry than in any other industry. Don't span scaffold planks more than what's allowed by OSHA for various loadings.

DO

Distribute loads evenly and place concentrated loads close to the legs or upright sections of the scaffold. Ask the scaffolding manufacturer or supplier what the load capacities of the legs and horizontal members of the scaffold frames are.

DON'T

Tamper with the scaffold or remove ties, planks, or guardrails, unless you're a trained scaffold erector who understands the consequences. All alterations to the scaffold should be performed by the designated trained personnel.

DON'T

Work on a platform without guardrails. Wind can blow you off, or when you're busy you can forget you're off the ground.

DON'T

Climb frames not designed for climbing. This includes cross braces, which when climbed on can slip off, causing the climber to fall.

DON'T

Climb with materials or tools in hands. And make sure hands and shoes are clean of mud or grease.

DON'T

Climb without a handhold above the platform. And don't use a ladder that is too short or not secured.

DON'T

Walk on icy, muddy, or snow-covered planking. Remove the ice or snow first and sand the planks to prevent slipping.

DON'T

Leave clutter around the base of the scaffold. Workers can trip on it or step on it when climbing down the scaffold. It also hides the ground, preventing you from noticing when ground conditions under the scaffold change.

Dismantling the scaffold

DO

Check for unauthorized alterations, particularly missing ties or cross braces, before dismantling. If necessary, install additional ties and cross braces needed to support the entire scaffold before you start to disassemble part of it. If you need to remove one portion of the scaffold, make sure the remaining portion is intact and complete.

DON'T

Drop or throw removed sections. Lower them to the ground as soon as possible.

Section IV: Estimating and Proper Stocking Techniques

Page 46	Terms and Definitions
Page 47	Stocking Material
Pages 48 - 50	Job Sheet for Stocking Exercise
Pages 51 - 53	Block and Brick Estimating
Pages 54 - 55	Assignment Sheets for Estimating Brick and Block

Trainee Section Objectives

1. To learn the following terms and definitions:

   a. Stockpiling
   b. Stocking
   c. Over stocking
   d. Banding material
   e. Modular brick
   f. Jumbo brick
   g. Length x course
   h. Length x height conversion
   i. Length to block conversion
   j. 1.13 (block) x sq. ft.
   k. 6.75 (brick) x sq. ft.
   l. Uniwall brick
   m. Cuts/parts

2. To correctly define, set-up, and stock block on starting ground level.
3. To correctly define, set-up, and stock modular brick at ground level.
4. To correctly define, set-up, and stock block and brick at ground level.
5. To correctly define, set-up, and stock block on scaffold.
6. To correctly define, set-up, and stock brick on scaffold.
7. To correctly define, set-up, and stock block and brick on scaffold.
8. To correctly define, set-up, and stock cuts and factory made units at corners, control joints, etc.
9. To correctly define stocking of reinforcement and control joint material.
10. To learn to correctly estimate block and brick quantities to be used.

Terms and Definitions:

Banding material — Metal straps used to hold bundles of brick together.

Control or expansion joint — A vertical joint or space to allow for expansion or contraction due to volume change. Sash block are used at these places on the wall.

Estimating — A near accurate count of masonry material to be used at a certain location so as not to overstock.

Length x course — A method of estimating by counting the number of units in one course and multiplying by the number of courses to be built.

Length x height — Change height of wall from feet and/or conversion method from inches to number of courses.

> **Example:** A wall is 48" high x 50 block long
> *Blocksize W=8", **H=8"**, L=16"*
>
> *48" ÷ 8" = 6 Courses*
> *6 courses x 50 block long = 300 Total Block*

Length of wall to number of block conversion (Technique 1) — A standard block is 16" in length, therefore, 3 block will equal 48" or 4'. If you divide the length of a wall by 4 (4') you can determine how many sets of three (3) blocks will be needed.

> **Example:** A wall is 100 ft. long.
> *Blocksize W=8", H=8", **L=16"***
>
> *100' ÷ 4= 25 sets of three blocks each*
>
> *25 x 3 = 75 block in each course*

Length of wall to number of block conversion (Technique 2)

> **Example:** A wall is 100 ft. long.
> *Blocksize W=8", H=8", L=16"*
>
Step 1:	Divide 100' in half	=	50
Step 2:	Divide 50' in half	=	25
Step 3:	Add totals from steps 1 & 2	=	75 Total block in course

Overstocking — Distribution of extra masonry material due to failure to estimate. Overstocked must be handled at least three times. "Extra Work" not needed by the Mason Tender.

Stockpiling — Large quantities of material that are kept in a designated area for future use.

Stocking — Distribution of masonry material near and handy to the mason to allow work to proceed as fast and efficiently as possible.

1.13 — A number used to estimate the number of wall units needed in a wall section.

> **Example:** A wall is 10' high by 50 ' long
>
> *Multiply 10 x 50 = 500 square feet*
> *500 x 1.13 = 565 units of block*

6.75 — A number used in estimating modular brick. Multiplying 6.75 by the number of square feet in a wall will give you the number of units needed for that particular wall.

> **Example:** A wall is 8' high by 75' long
>
> *Multiply 75 x 8 = 600 square feet*

Stocking Material

It is very important that your stockpile of material on the jobsite doesn't get too low, especially in weather that may cause muddy conditions. Notify your foreman in time to order new supplies. If your job has a forklift, material can be "double-decked" to conserve space. If not, don't allow the delivery truck driver to do this. It is too high for you to reach to get the material down.

When stocking a wall, use common sense. Hurrying too much, with no planning, can cause you more work. Stock the proper amount of material; be accurate in setting up a wall with brick and block. If you put up too many, they will have to be taken back down.

Handle the material carefully. Many of the masonry units used today are very expensive, so careless handling may cause unnecessary costs to the employer. Badly chipped or defective material should not be stocked. Use tin snips to cut the banding that holds together the bundles that most bricks and blocks come packaged in. Breaking them with a hammer or prying them apart can chip or break the material, causing more unnecessarily damaged units.

Stocking an area accurately, in the least amount of time is important. Use brick-tongs, brick buggies, and other labor-saving tools and equipment. Inefficiency in a mason tender, as well as any other worker, will be spotted right away.

Ask workers below to step aside when you stock material, especially when a large load is set in place.

When a wall is stocked with bricks and blocks, place the blocks next to the mortar board; this will keep mortar spatter off of the face brick. Keep heavy loads directly over the scaffold frames.

Try to keep the material within easy reaching distance of the bricklayer, but not so close as to be in the way. The half blocks and cuts should be stocked close to where the bricklayers are using them. Horizontal reinforcing and wall ties should be kept within reaching distance of the bricklayers.

Think ahead, try to have the material ready for the bricklayers before they ask for it.

When stocking blocks, they should be stacked with the thick side of the webs up. This makes them easier to pick up. The only exception to this is 4" blocks; most bricklayers want them stacked with the hollow side up. Since the holes in 4" blocks do not go clear through, they are usually stacked upside down.

When stocking material for bricklayers who are working on scaffolds with catwalk brackets, don't stack the material too high. If the catwalks are in a low position, the masons have to reach too high to get to the top of the material. This cuts down on their production and makes them work harder to get the same job done. Stock blocks only 3 or 4 units high.

If you are using a forklift to raise material, there are several things you should be aware of; watch the weight of material being lifted with your forklift; know the limits of the equipment you work with; never turn the wheels with the load raised up high. (This could overturn the machine.) Instead, approach the scaffold as close as possible with the material in a down position, then raise the material and pull straight ahead or boom in the mast of the forklift to place it on the scaffold. The higher the material is to be raised, the more important it is to observe this rule.

Use the forklift to your advantage. Lift one or two batches of mortar at a time on the scaffold by using a mortar tub. Also use it to raise reinforcing steel.

Section IV: Job Sheet

Exercise #1, Set-up and Proper Stocking Techniques

1) Check to make sure you have:

hard hat	gloves	hammer
keel or marking device	reinforcing steel	shovels
tin snips	tape measure	block
brick	Duro-wall	wall ties

2) Proper set-up and stocking technique of block at ground level.

Beginning at the concrete foundation corners, measure approximately 30" out from the footer and, if ground is uneven, level the ground from approximately 30" to 60" the length of the wall as good as possible so block can set flat on the ground and won't fall over when more block are stacked on them. At this point you can begin stocking procedure (see Fig. 4-1). The block width will determine how many can be placed aside of one another. When block is stocked side by side, the width of the stack of block should not exceed 5' and the height should not exceed 4'.

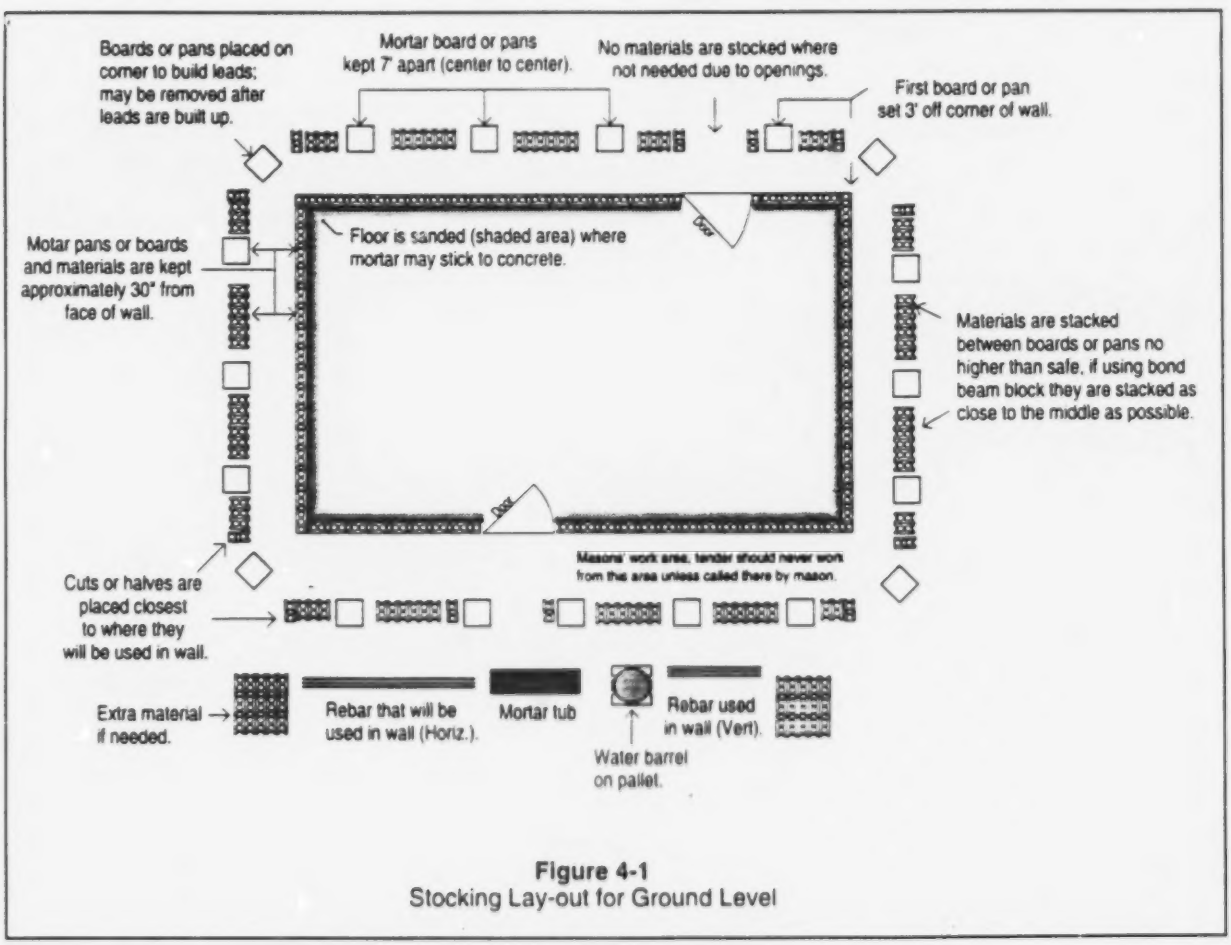

Boards or pans placed on corner to build leads; may be removed after leads are built up.
Mortar board or pans kept 7' apart (center to center).
No materials are stocked where not needed due to openings.
First board or pan set 3' off corner of wall.
Floor is sanded (shaded area) where mortar may stick to concrete.
Motar pans or boards and materials are kept approximately 30" from face of wall.
Materials are stacked between boards or pans no higher than safe, if using bond beam block they are stacked as close to the middle as possible.
Masons' work area, tender should never work from this area unless called there by mason.
Cuts or halves are placed closest to where they will be used in wall.
Extra material if needed.
Rebar that will be used in wall (Horiz.).
Mortar tub
Rebar used in wall (Vert).
Water barrel on pallet.

Figure 4-1
Stocking Lay-out for Ground Level

3. Stocking brick at ground level - Basically the same procedure is used for stocking brick at ground level as for block, except brick do not take up as much room as block, so mortar boards can be placed at closer intervals. Brick bundles can be placed with the forklift or with a brick buggy, which makes them easier to stock.

4. The same procedures can be used when preparing surface for stocking brick and block as for the previous set-ups. Refer to paragraph 2 of this section. If 8" block or wider is being used one or two less stacks would be stocked. Otherwise stocking could continue typical to what is shown in Figure 4-1. Stack brick in the center of block stocks to keep face clean of mortar splash.

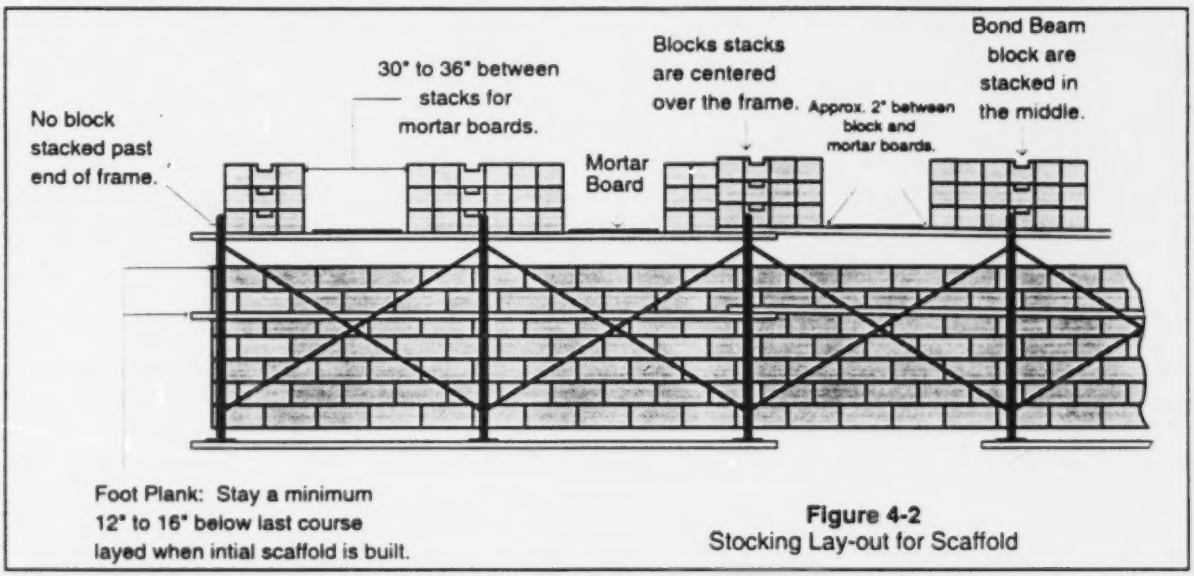

30" to 36" between stacks for mortar boards.
Blocks stacks are centered over the frame.
Bond Beam block are stacked in the middle.
No block stacked past end of frame.
Approx. 2" between block and mortar boards.
Mortar Board
Foot Plank: Stay a minimum 12" to 16" below last course layed when intial scaffold is built.

Figure 4-2
Stocking Lay-out for Scaffold

5. Stocking block on a scaffold - Refer to Figure 4-2 and 4-3. Always begin stocking on scaffold by placing material directly over scaffold frames for maximum support. Note this on the illustrations.

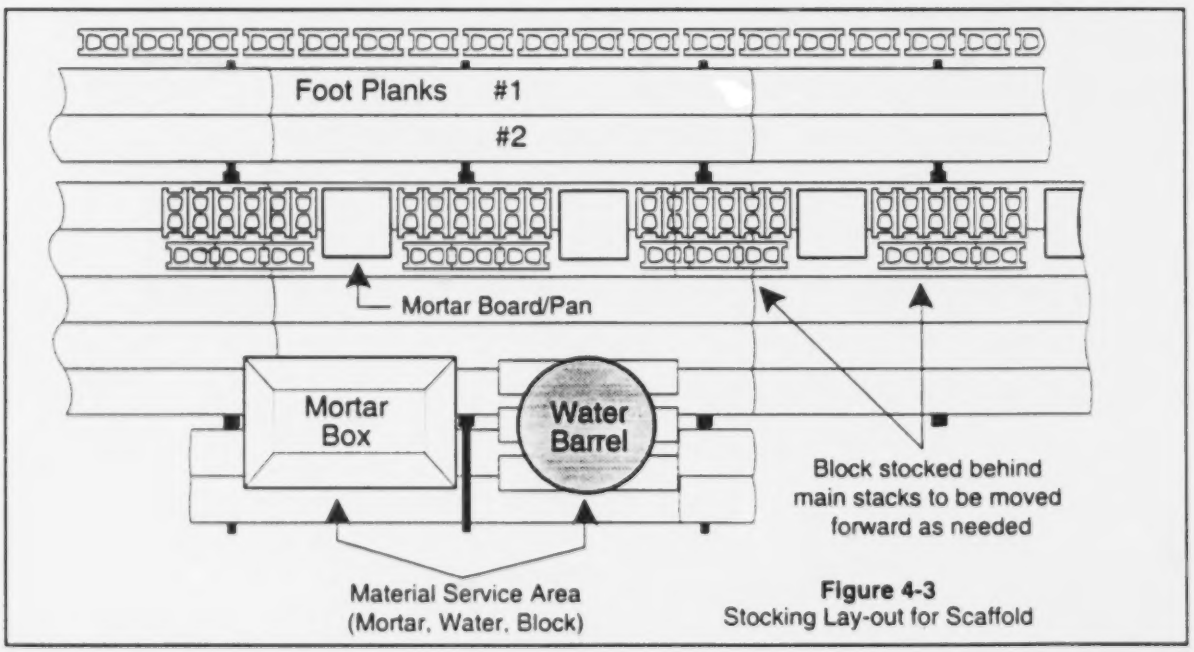


Figure 4-3
Stocking Lay-out for Scaffold

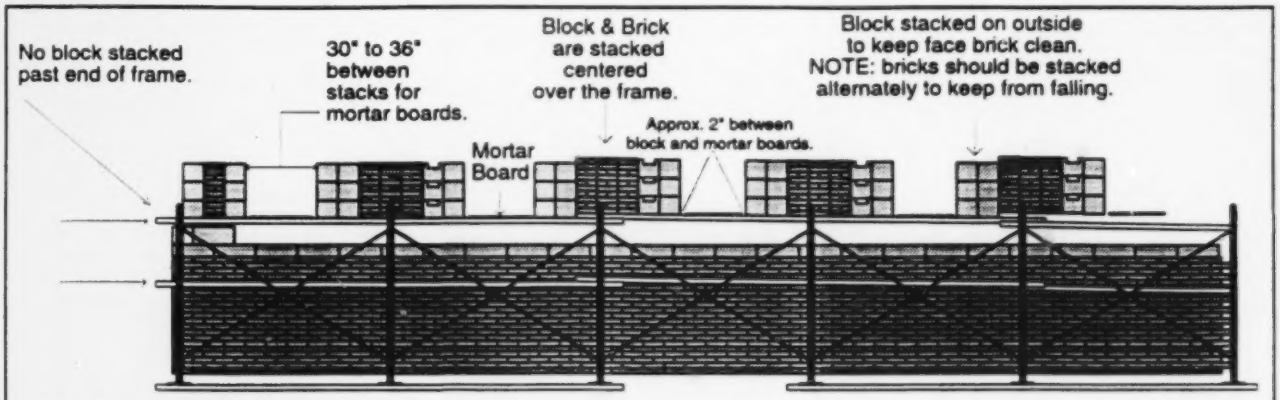

No block stacked past end of frame.
30" to 36" between stacks for mortar boards.
Block & Brick are stacked centered over the frame.
Block stacked on outside to keep face brick clean. NOTE: bricks should be stacked alternately to keep from falling.
Approx. 2" between block and mortar boards.
Mortar Board
Foot Plank: Stay a minimum 12" to 16" below last course layed when intial scaffold is built.

Figure 4-4
Stocking Brick and Block on Scaffold

6. Stocking brick and block on scaffold - Figure 4-4 shows a bundle of brick with 6" block stocked on either side. If 8" block or wider is being used one or two less stacks would be stocked. Otherwise stocking could continue typical to what is shown.

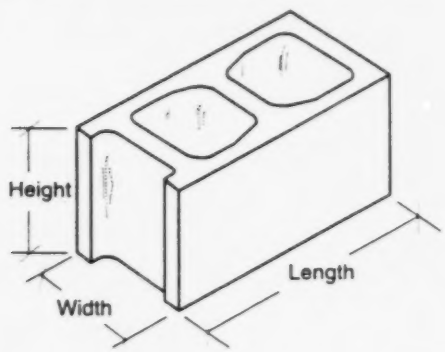
7. Masonry saw cuts and factory made cuts are usually used on corner leads, at doorways, windows, and expansion joints. You will see this after the layout man has laid the first course.

8. Stocking of reinforcement and expansion joint material should be done in conjunction with the masonry material. Duro-wall/reinforcement wire can be placed on the ground out of the way, and handed to the mason as he needs it. When stocking Duro-wall on the scaffold it may be placed on the ladder rungs of the scaffold where the mason can reach it. Expansion joint material can be placed on the scaffold behind the stocked material. The same can be done with strap anchors and wall ties.

Block and Brick Estimating

Mason tenders must be able to estimate materials for daily work projects. The majority of estimating mistakes are simple arithmetic errors. Basic arithmetic skills in adding, subtracting, multiplying, and dividing can solve estimating problems. Materials that are overstocked or understocked create wasted labor, time, and money. Most estimating is done using the square foot method because it is simple and accurate. The length of the wall is multiplied by the height of the wall to find square foot area, then the openings are subtracted.

When estimating brick it is important to know the size of the brick to be used. Unlike concrete block, brick are manufactured in numerous sizes. Brick are more commonly identified by the actual dimensions rather than a name. Dimensions are always written in the same order; W (width) x H (height) x L (length).



Brick are purchased using actual dimensions. Brick and block must be estimated using nominal dimensions. Table 4-1 shows actual and nominal dimensions for common brick and block sizes and the number of each size in a square foot of wall. Note: Nominal dimensions use actual size of brick or block plus a mortar joint. Figure 4-5 shows an example of these dimensions.

Example 1:
A wall is to be built 8' high and 20' long, using common block (8x8x16) and modular brick (6.75/sq. ft.). How many units of block and brick will be needed?

a. Find square footage of wall

   20' x 8' = 160 total square feet (sq. ft.)

b. From Table 4-1 we can locate the number of block and brick per sq. ft.

   - Block = 1.13 per sq. ft.

   160 sq. ft. x 1.13 per sq. sq. = 180.8 or 181 block total

   - Brick = 6.75 per sq. ft.

   160 sq. ft. x 6.75 per sq. ft. = 1,080 brick total

Example 2:
Build a wall 12' high and 32' long. How many block will be needed if using 8x8x16 running bond?

a. Find sq. ft. of wall:

   12 x 32 = 384 sq. ft.

b. Total number of block equals:

   384 x 1.13 = 433.92, or 434 block

Another method of estimating block is to convert height of wall to number of courses and length of wall to number of blocks per course. Example 3 shows this method of estimating.

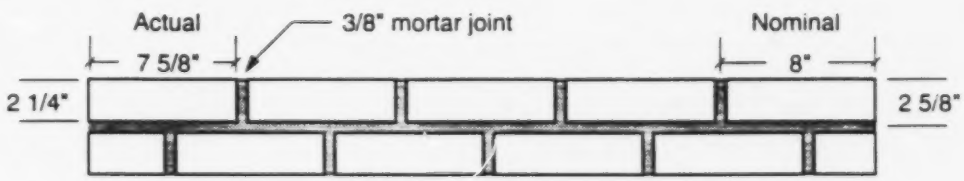


Figure 4-5
Example of Actual and Nominal Dimensions

Example 3:
Build the same wall as described in example 2.

a. 4" high block = 3 courses per 1' vertical
6" high block = 2 courses per 1' vertical
8" high block = 1.5 courses per 1' vertical
Block that is 16" in length = 3 block per 4' horizontal

b. Find number of courses high:

8" high block = 1.5 courses per 1' vertical
12 x 1.5 courses per foot = 18 courses

c. Find horizontal length:

16" long block = 3 block per 4' horizontal
32' ÷ 4' = 8 x 3(block per 4') = 24 block per course

d. Determine total number of block:

18 courses x 24 block per course = 432 total block

Another method of estimating this example follows.

a. Number of courses high:
Find total height of block in inches and divide by height of each block (inches).

Height is 12' x 12" = 144" ÷ 8" = 18 courses

b. Horizontal length:
Find total length of block in inches and divide by length of each block (inches).

Length is 32' x 12" = 384"
384" ÷ 16" = 24 block per course

c. 18 courses x 24 block long = 432 total block

As you can see there is some variance between examples 1, 2 and 3. That's why it is called estimating. A good practice is to estimate as close as possible and add a few extra in case of breakage or chipped blocks.

When walls have openings such as windows and doors these areas must be calculated and subtracted from the total square foot area to provide an accurate estimate. These openings are called negative quantities.

Example 1:
Build new store front wall using 8" x 8" x 16" block and Norman brick for facing. Wall is 10'-8" high and 36' long. The wall has two windows 48" x 32" and 1 door 7'-4" x 4'-0".

a. Find sq. ft. of wall:
Convert 10'-8" to decimal
10' + 8"
10' + $^{8}/_{12}$"
10' + .67'
10.67' high x 36' long = 384.12 sq. ft.

2. Find sq. ft. of openings:
48" ÷ 12" = 4.0'
32" ÷ 12" = 2.67'
4' x 2.67' = 10.68'
10.68' x 2 windows = 21.36 sq. ft.

7'-4" = 7.33'
4'-0" = x 4.00'
1 door = 29.32 sq. ft

21.36 sq. ft. + 29.32 sq. ft. = 50.86 sq. ft. of openings

3. Find sq. ft. of block and brick:
384.12 total sq. ft.
- 50.68 total sq. ft. of openings
333.44 sq. ft. of block and brick

4. Find number of block needed for the wall:
333.44 sq. ft.
x 1.13 no. of block per sq. ft. (from Table)
376.79 or 377 total block

5. Find number of brick for the wall:
333.44 sq. ft.
x 4.55 no. of brick per sq. ft. (from Table)
1517.15 or 1518 total brick

Example 2:
Build an 8" thick wall with 8 x 8 x 16 block. Size of wall is 12' x 32', running bond.

1. Find square feet of wall:
32' (length of wall)
x 12' (height of wall)
384 square feet

2. 384 square feet of wall
x 1.13 No. of 8x8x16 block per sq. ft. (from Table)
434 total block

Table 4-1 : Number Per Sq. Ft. For Running Bond or Stock Bond

Brick	Dimensions W H L	Name of Brick	No. per sq. ft.
Actual Nominal	3 5/8 x 2 1/4 x 7 5/8 4 x 2 5/8 x 8	Modular	6.75
Actual Nominal	3 5/8 x 2 1/4 x 8 4 x 2 5/8 x 8 3/8	Standard	6.5
Actual Nominal	3 5/8 x 2 3/4 x 8 4 x 3 1/8 x 8 3/8	Jumbo	5.5
Actual Nominal	4 x 2 3/4 x 8 1/2 4 3/8 x 3 1/8 x 8 7/8	Oversize	5.20
Actual Nominal	3 5/8 x 2 1/4 x 11 5/8 4 x 2 5/8 x 12	Norman	4.55
Actual Nominal	3 5/8 x 2 3/4 x 11 5/8 4 x 3 1/8 x 12	Jumbo Norman	3.85
Actual Nominal	3 5/8 x 3 5/8 x 11 5/8 4 x 4 x 12	Utility	3.0
Actual Nominal	3 5/8 x 7 5/8 x 7 5/8 4 x 8 x 8	Quad	2.23
Actual Nominal	3 5/8 x 11 5/8 x 11 5/8 4 x 12 x 12	Panel	1.0
Actual Nominal	5 5/8 x 3 5/8 x 11 5/8 6 x 4 x 12	Thru Wall Utility	3.0
Actual Nominal	7 5/8 x 3 5/8 x 11 5/8 8 x 4 x 12	Thru Wall Utility	3.0
Block	**W H L**		
Actual Nominal	7 5/8 x 7 5/8 x 15 5/8 8 x 8 x 16		1.13
Actual Nominal	7 5/8 x 5 5/8 x 15 5/8 8 x 6 x 16		1.51
Actual Nominal	7 5/8 x 3 5/8 x 15 5/8 8 x 4 x 16		2.30

Block and Brick Estimating

Total block = T.B.
Regular = Reg.
Bond beam = B.B.

1. **Block 8" x8"x16"**
   6 courses high
   40 block long

   How many T.B. ___

2. **Block 8" x8"x16"**
   8 courses high
   63 block long

   How many T.B. ___

3. **Block 8" x8"x16"**
   12 courses high
   22 block long
   1 course of B.B. in the 12 courses high

   How many T.B. ___
   How many Reg.___ + B.B.___

4. **Block 8"x4"x16"**
   44 block long
   40" high
   1 course of B.B.

   How many T.B. ___
   How many Reg.___+ B.B.___

5. **Block 6"x6"x16"**
   92 block long
   72" high or 6'
   2 courses of B.B.

   How many T.B. ___

6. **Block 6"x8"x16"**
   36 block long
   4' high
   1 course of B.B.

   How many T.B. ___
   How many Reg.___ + B.B.___

7. **Block 8"x4"x16"**
   240' long=___ block long
   6'4" high=___ courses high
   2 courses of B.B.

   How many T.B. ___
   How many Reg.___ + B.B.___

8. **Block 4"x6"x16"**
   84' long=___ block long
   36" high=___ courses high
   1 course of B.B.

   How many T.B. ___
   How many Reg.___ + B.B.___

9. **Block 8"x8"x16"**
   100' long=___ block long
   6' high=___ courses high
   2 courses of B.B.

   How many T.B. ___
   How many Reg.___+ B.B. ___

10. **Block 6"x8"x16"**
    130' long=___ block long
    4'8" high=___ courses high
    1 course of B.B.

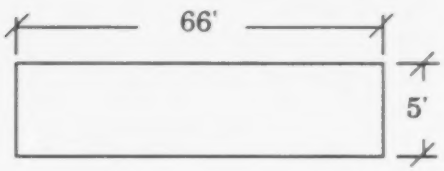
    How many T.B. ___
    How many Reg. ___ + B.B. ___

Block and Brick Estimating Cont.

11. Area = 90' wide and 110' long. There are 4 brick to a square foot.
How many brick in this area?

12. Area = 4' wide and 250' long. There are 6 1/2 brick to a square foot.
How many brick in this area?

13. It takes 5 1/2 brick to a square foot.
How many brick in the area shown below?

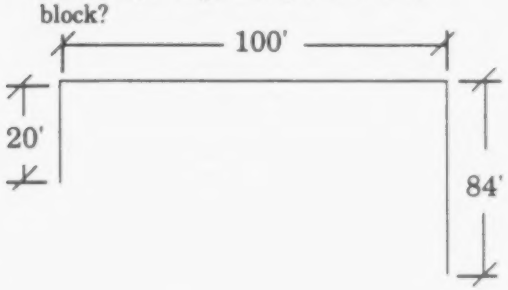


14. You are making a brick patio, 60' wide, 80' long. It takes 3 1/2 brick to a square foot.

How many pailets of brick will it take if there are 500 brick on a pallet? _____

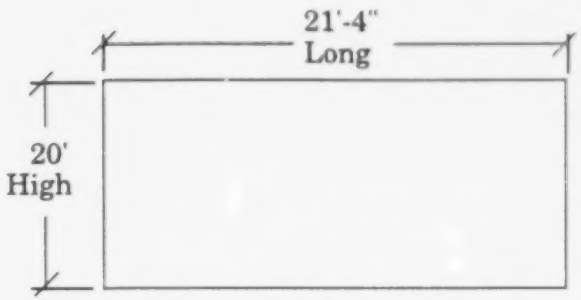
15. What is the total linear footage of the wall shown below? _____

How many block will it take to build this wall, 6' high using 6" x 6" x 16" block?

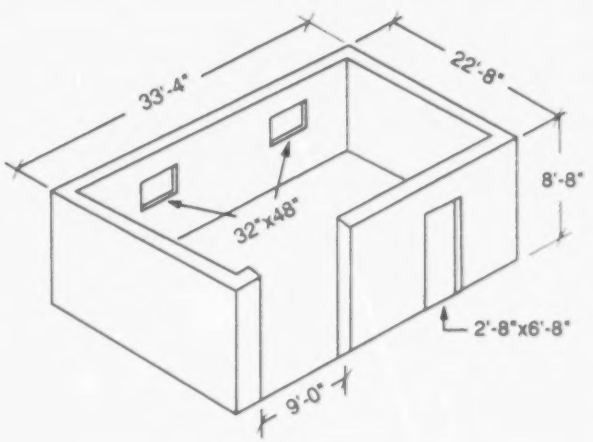


16. How many block will it take to build this wall using 8" x 4" x 16" block?

* 4 ft. long equals 3-16" long block.



17. How many block and brick will it take to build this garage, using 8" x 8" x 16" block and Jumbo Norman brick?



Section V: Mortar and Grout Mixing

Page	58	Terms and Definitions
Pages	59 - 61	Mixing Mortar
Pages	62 - 63	*The Right Way to Mix Mortar*
Pages	64 - 66	*Laying Masonry in Cold Weather*

Trainee Section Objectives

1. To learn the following terms:

a.	mortar	h.	coloring/admixture
b.	grout	i.	masonry cement
c.	mud	j.	portland cement
d.	lime	k.	mortar box
e.	mixer(s)	l.	tempering can
f.	mortar hoe	m.	accelerator
g.	doctoring	n.	retarder

2. Describe the two types of power mixers.
3. Describe the proper set up of mixer(s) and materials.
4. Describe the proper personal protective equipment necessary when mixing mortar.
5. Define the main ingredients necessary for mixing mortar.
6. Define the three types of mortar.
7. Describe the correct step by step procedures on mixing mortar in a power mixer.
8. Describe the correct step by step technique when mixing mortar by hand.
9. Describe the proper technique when coloring is to be added to the mortar.
10. Describe the main ingredients necessary for mixing grout.
11. Describe the proper procedures for shutdown and clean-up for mixers and mortar box.

Terms and Defintions

Mortar	A mixture of portland cement, lime, sand, and water that hardens and is used in masonry and plastering.
Grout	A mixture of portland cement, sand, coarse aggregate, and water that is stronger when it hardens but not as workable as mortar.
Mud	A slang term for mortar, other slang terms include: go-between, headjoints, glue.
Lime	A caustic solid that consists of calcium oxide and magnesia, that is used in masonry mortar mix.
Mixer(s)	Power machinery (gas or electric) used to aid the mason tender in mixing large amounts of mortar and grout, fast and efficiently. There are two types of mixers; paddle and barrel. Paddle mixers are used mainly for mixing mortar, while barrel mixers are used mainly for mixing grout and dry mixes.
Mortar hoe	A tool resembling a garden hoe with the exception of having a larger head with holes in it used in mixing mortar and grout by hand.
Coloring	An admixture used for changing the color of mortar or grout to whatever color is desired.
Portland cement	One of the main ingredients used in mixing mortar and grout.
Masonry cement	An ingredient that has lime incorporated in it. Masonry cement, sand, and water will produce a creamier, somewhat weaker mortar.
Mortar box	A large metal or wooden box used to mix mortar or grout by hand. May be used to transport the mortar.
Tempering	To moisten and remix mortar to a proper consistency for use; also called retempering.
Tempering can	A 1 or 2 gallon capacity can, used to dispense small quantities of water when tempering mortar, or when small amounts of water are needed in the mixing process.
Doctoring	A process used in the event the mortar mix becomes too soft. Small proportionate amounts of the mix ingredients are added to the soft mortar rotating in the mixer until the proper consistency is attained.
Accelerator	Any additive or substance added to mortar during the mixing process that will speed up the set of the mortar or to hasten the development of the mortar's natural strength. Normally used during cold weather.
Retarder	A substance or additive used to slow the setting process in mortar. Normally used during hot weather.

Mixing Mortar

If you are assigned to be the mortar mixer, make sure that mortar is on the boards at the time the bricklayers start to work. Generally, you will be allowed "starting time" which will give you a half hour head start to mix the mortar.

Save yourself work -- keep all material close to the mixer. Have the sand, cement, lime, and water all within a few steps of each other. (Figure 5-1).

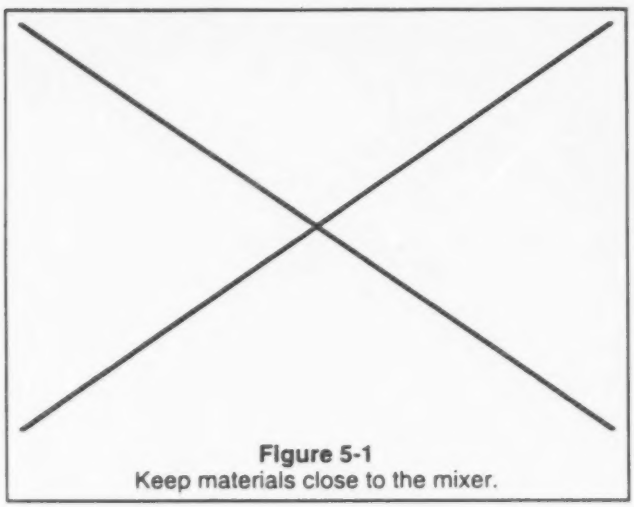


Figure 5-1
Keep materials close to the mixer.

Keep the cement and lime on pallets; this will prevent them from getting wet from the ground and will allow a forklift to move them if the mixer location must be changed.

Measure your mix proportions accurately. The strength of the wall depends greatly upon the mortar. Don't guess, measure all materials that are put into the mixer.

When mixing colored mortar, be very accurate in measuring all of the ingredients, not just the coloring. An error on your part can be very costly to correct later.

A batch of mortar should not be allowed to sit in the mixer for a long period of time without mixing, especially in hot weather. A mixer can be ruined by forcing it to mix mortar after it has begun to "set up". You may have to dig the stiff mortar out of the mixer with a shovel or pick once it has begun to harden. Mortar should not be left mixing for too long, since water will eventually have to be added, changing the mortar strength. Avoid getting dirt, rocks, or other trash mixed in with the sand and cement. It is very important that mortar be mixed to the proper consistency. If it is too wet it will slow down the bricklayers and smear the bricks; while mortar that is too dry will cause you extra work by requiring your time to temper it up often.

Types of Mixers

There are two types of power mixers; they are barrel and paddle, which are gas or electric powered.

It is a pleasure to work with clean equipment. A mixer that is kept clean will be less trouble to clean at night than one that is allowed to build up mortar and become dirty. A coat of motor oil or form oil will help keep mortar from sticking to both the outside and inside of the mixer.

Sometimes, the wheels of a mixer have to be set on blocks to raise it high enough to permit easier dumping of mortar into the wheel barrow or mortar tub (Figure 5-2).

Keep your mixer in good working order. If possible, keep spare pulley belts available and an extra spark plug (if gas mixer) in your tool box. Also handy are extra hose couplings and rubber washers. If the hose starts to leak, take a few minutes to fix it. Leaky hoses cause you and others unnecessary mess.

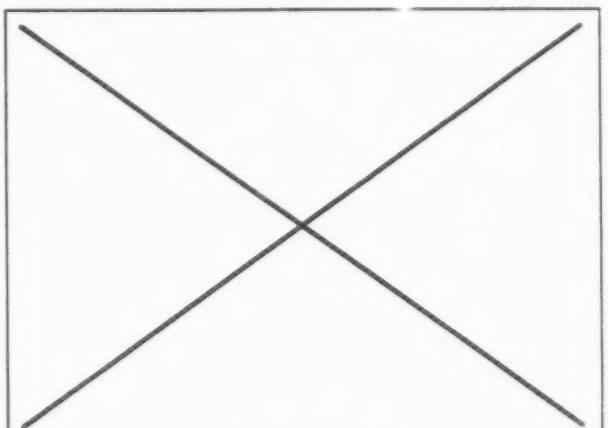


Figure 5-2
Set the mixer on blocks to allow for easier unloading of mortar.

If you have to work on the mixer, always turn it off if it is a gas mixer, and unplug it if it is electric. Your could be seriously hurt if the gears become engaged while you are working on it.

Proper Mixing Sequence

With the mixer running, put in about 3/4 of the water that will be needed, about half of the sand required, and add the cement required.

Mix batches requiring full sacks whenever possible; it is easier than splitting a sack. Next, add lime if making lime mortar. At this point the mix may be getting too dry; if so add water with a small can until it is wet enough to mix properly. Add final half of the amount of sand needed and the rest of the water as needed to make the mortar the proper consistency. Let this mix for at least five minutes.

Types of Mortar

You should be aware of the different kinds of mortar and the amount of sand, cement, and lime needed to make each type. Table 5-1 will explain the different types.

Table 5-1: Mortar Types

Masonry Cement Mortar:
1 part masonry cement
3 parts sand

Portland Mortar Types:

Mortar type	Portland cement	Lime (hydrated)	Sand (approx.)
M	1	1/4	3
S	1	1/2	4 1/2
N	1	1	6

These same types (M,S,N) can also be made using Portland cement, Masonry cement, and sand using the following mix porportions:

Mortar type	Portland cement	Masonry cement	Sand (approx.)
M	1	1	3
S	1/2	1	4 1/2
N		1	3

Generally speaking, 3 shovels of sand can be mixed with each shovel of Portland cement, lime, or masonry cement.

Table 5-2: Proportions By Batch

Mortar type	Portland cement	Lime	Sand
M	1 bag	1/4 bag	21 shovels
S	1 bag	1/2 bag	31 shovels
N	1 bag	1 bag	42 shovels

Mortar type	Portland cement	Masonry cement	Sand
M	1 bag	1/4 bag	21 shovels
S	1 bag	1/2 bag	31 shovels
N	1 bag	1 bag	42 shovels

If you are going to mix by the batch Table 5-2 will give you a guide for proportions.

Table 5-3: Proportions for Grout

Portland cement	Sand	Aggregate (pea gravel or 3/4" MSA)
1 bag	24 shovels	16 shovels

Mixing Grout

Ingredients necessary for grout are Portland cement, sand, aggregate, and water. Table 5-3 shows a generally accepted mix, but you should always check with your foreman if you are uncertain of the proper mix ratio.

Winter Operation

Whenever possible, use heated mixing water during cold weather. This helps prevent the mortar from freezing. Keep the sand pile covered with a heavy canvas or an old rug to keep snow and moisture out. Sand will not freeze if it is kept dry.

In cold weather, thoroughly drain the water hose every night, unless it is kept stored in a heated building. Frozen hoses can cause the entire crew to lose half a day's work while the hoses are being thawed out.

Cleaning the Mixer

Clean up and shut down of the mixer is done when no more mortar or grout is needed. With the mixer turned off, and disconnected (if electrical) scrape down the sides and tub of the paddle mixer using a margin trowel or an old masonry trowel.

When cleaning a paddle mixer, put about 5 gallons of water into the mixer and start it up. Add about 5 shovels of sand, and with the paddles turning you may drop some empty lime bags into the mixer (being careful not to jam it up). After a few minutes, dump the water and papers into a wheel barrow or mortar tub and dispose of away from the mixing area. Using a water hose and nozzle, rinse the remaining mortar from the mixer into a wheel barrow and dump it away from the mixing area.

If you are cleaning a barrel mixer, add about 5 gallons of water to the mixer as it is rotating. Add some gravel or masonry pieces of rubble and let the mixer run as you cover the cement and lime with a tarp or plastic sheeting. Empty the mixer into a wheel barrow and dispose of away from the mixing area. Rinse and dispose of the rest of the refuse away from the mixing area.

In cold weather, thoroughly drain the water hose every night, unless it is kept stored in a heated building. Frozen hoses can cause the entire crew to lose half a day's work while they are being thawed out.

The Right Way To Mix Mortar

Since mortar is the one material the masonry contractor makes on the job, its consistency is most likely to vary. These variations affect mason productivity and mortar strength. Despite this, the person who mixes the mortar usually has very little training. What's the right way to mix mortar?

Proportioning the mix

A good mortar mix starts with the basics - the proportions. Contract documents should specify what type of mortar to use: Type M, S, N, or O, as detailed in ASTM C270, Standard Specifications for Mortar for Unit Masonry. The table lists the amounts of sand, lime, and portland or masonry cement needed to produce a cubic yard of mortar for each type of mortar. So the mixer operator always knows how much of each ingredient to add, post the mix proportions for the specified mortar near the mixer. One person may be trained to make the mortar, but he or she may forget the proportions after a long weekend, or others might have to step in when that person is sick or on vacation. Check and double check that the proper proportions for the specified mortar are being used.

Measuring materials

Some organizations, including the Brick Institute of America (BIA) and the Office of the State Architect of California, do not permit measuring ingredients by shovel. This is not a problem for portland or masonry cements. Packaged in 1-cubic-foot bags, they can be added to the mixer in cubic-foot increments. This can be a problem for sand and sometimes for lime. Sand is often batched by shovel. If shovel measurements are not allowed, construct 12x12x12-inch wood boxes to measure the sand in 1-cubic-foot increments. Or use proprietary equipment designed specifically for measuring sand. Even if shovel measurements are permitted, it's wise to know how many shovels will fill a 1-cubic-foot box.

Lime is packaged in 1 and one-fourth cubic-foot bags. Depending on the proportions of the mortar and the size of the mixer, lime is batched by bag, by shovel, or by measuring box.

Control the moisture content?

Moisture affects the weight and volume of materials. Cementitious materials must be protected from moisture, but sand often is not. As sand absorbs rain or ground water, it gains weight and volume. ASTM C270, however, allows the volume of sand to range from $2\frac{1}{4}$ to 3 times the total volume of cementitious materials. Thus it's usually not necessary to control the moisture content of the sand or to adjust the mix volume of the sand for moisture.

However, it's easier to produce uniform mortar from batch to batch if the sand is uniformly moist. Some admixtures, especially coloring pigments, are also affected by changes in moisture. To help maintain a uniform moisture content, cover sand piles with polyethylene.

Mixing the ingredients

The way the materials are mixed may vary, but the following order has been proven to be successful: Place $\frac{3}{4}$ water, $\frac{1}{2}$ sand, and all the cementitious materials in the mixer and mix them for a few minutes. Then add the remainder of the sand and enough water to produce the desired consistency. The amount of water needed is not usually stated in the project specifications; it is determined by the masons and the mixer operator.

After all the materials have been added, mix the mortar again - for at least 3 minutes but no more than 5 minutes. Shorter mixing times may result in non-uniformity, poor workability, low water retention, and less than optimum air content. Longer mixing times may adversely affect the air contents of mortars containing air-entraining cements or air-entraining limes. The mixer drum should be completely empty before the next batch is charged.

Hand mixing

Although most specifications discourage hand mixing, some allow it on small jobs after approval of a specific mixing plan. If mortar is mixed by hand, the sand should be spread in the mortar box first, then the cementitious materials should be spread uniformly over the sand. Mix the dry materials well with a hoe from both ends of the box. Then add about $\frac{3}{4}$ of the water (for dry sand, about 2 gallons of water per cubic foot of material) and mix until all the

materials are uniformly damp. More water can then be added to obtain satisfactory consistency. Let the batch stand for about 5 minutes and then remix thoroughly with the hoe without additional water.

Retempering

Mortar should be mixed at the rate that it can be used. This way, the workability remains the same throughout the day. If the mortar dries and stiffens before use, workability can be restored by adding more water and remixing - as long as the mortar is no more than 2½ hours old. Although retempering may slightly reduce the compressive strength of the mortar, plastic mortar bonds better with the masonry units. Bond usually is much more important than compressive strength.

Never retemper colored mortar; additional water may lighten the mortar's color.

The mixing site

Locate the mortar mixing site so it has easy access to water and ample space for material storage. Try to place it near the work area, away from traffic, and protected from sun, wind, rain - and vandalism and theft. If necessary, consider having two or more mixing sites.

A large mixing area is usually not necessary and in some urban locations not possible. However, a site that's large enough to store the material required for 1 week's mixing is desirable. This, of course, depends on the job and the number of workers on the job. To calculate the amount of mortar needed in a week, first estimate the amount of masonry that can be laid in a week. According to one masonry contractor, a mason can lay about 200 block or 680 standard brick in an 8-hour workday. This same contractor also says 1 cubic yard of mortar is required to lay about 350 block or 1,000 brick. Thus, one mason needs 2.9 cubic yards of mortar to lay 1,000 block in a week or 3.4 cubic yards of mortar to lay 3,400 brick in a week.

Use Table 5-4 on this page to determine how much of each material is needed to produce this amount of mortar, depending on the type of mortar used.

It's preferable, but not always economical, to have all the sand and cementitious materials that are needed for one phase of the job delivered before work begins on that phase. If the materials are properly proportioned, the sand should run out at the same time the cement does. If not, the contractor knows the mortar has had too much or not enough sand.

TABLE 5-4: THE QUANTITIES OF MATERIALS NEEDED TO MAKE A CUBIC YARD OF MORTAR

Mortar Type	Sand Cubic Feet*	Portland Cement (cu. ft)	Masonry Cement** (cu. ft.)	Lime (cu. ft.)
M	27	-	9.0	-
	27	7.5	-	2.0
S	27	-	9.0	-
	27	6.0	-	3.0
N	27	-	9.0	-
	27	4.5	-	4.5
O	27	-	9.0	-
	27	3.0	-	6.0

* *A cubic yard of sand does not produce more than a cubic yard of mortar. Voids in the sand are filled by cementitious materials.*

** *Value shown assumes Type M mortar is made with Type M masonry cement, Type S mortar is made with Type S masonry cement, and Types N and O mortars are made with Type N masonry cement.*

The Right Way

The best way to make consistent mixes is to train the mixer and his or her backup. Post the mix proportions at the mixer. Calibrate the shovel used to batch sand with the number of shovels needed to fill a 1-cubic-foot box. And batch and mix all the ingredients the same way for each batch or mortar. The result: a quality product and more productive masons.

Laying Masonry In Cold Weather

Masonry work changes at about 40 degrees F. Below this temperature, masons must begin taking special precautions to keep themselves and the masonry warm. If they don't, their productivity and the quality of the masonry decreases.

The problem with cold weather

Cold weather does more than just make masons uncomfortable. It also reduces the strength development of freshly laid masonry. There are two reasons for this: slower hydration of the portland cement in the mortar and destructive expansion of the mortar as the water in the mortar freezes.

Mortar hydration requires water and above-freezing temperatures. Without either of these, mortar cannot gain strength. If the mix water freezes, there's no water available to hydrate the cement. Even if the water doesn't freeze, hydration is slowed considerably at lower temperatures, resulting in lower early strength.

Expansion that occurs when water freezes also can cause damage. If the mortar contains more than 6% water, the expansion due to freezing will be great enough to crack the mortar. Therefore, in cold weather, masonry should be protected until the water content of mortar drops below 6%. This can be done by protecting the masonry units from freezing. Cold masonry units containing no frozen water can absorb enough water to lower the water content of the mortar below 6%.

Mortar that freezes has exceedingly high compressive strength, but when it thaws its strength is low. If the mortar contains less than 6% water, the masonry can regain strength after thawing if it is properly wetted.

Even after rewetting, though, the mortar is not as weather resistant or as water tight as mortar that has never been frozen. If the masonry is rewetted, the architect or engineer should specify how the masonry should be wetted and how to test if the procedure worked. Normally, the wall is wetted after the last freeze in the spring. Although this procedure may be possible, it's always best to prevent the masonry from freezing. Many designers would prefer to have the wall rebuilt instead of wondering if it gained enough strength after freezing.

If the mortar contains more than 6% water at the time of freezing, strength cannot be regained after thawing even if the masonry is wetted. Too much void space is created in the mortar when the water freezes and expands.

Selecting materials

Generally, no special materials are required to produce mortar at low temperatures. The contractor may, however, decide to speed hydration by using a high-early cement (Type III) or by using an accelerator. Type III cement may change mortar color. Use of an accelerator should not change requirements in Table 5-1 unless the accelerator has been tested and found to perform satisfactorily in masonry mortars at the temperatures the mortars will be used.

Calcium chloride can be used as an accelerator, but because it corrodes metal, don't use it in masonry that contains joint reinforcement, wall ties, anchors, or other metal. If it is used, don't use it in amounts greater than 2% by weight of portland cement or 1% by weight of masonry cement. Non-chloride accelerators also are available, but they cost more than calcium chloride.

Accelerators are sometimes incorrectly called antifreezes, although they do not significantly reduce the freezing point of the liquid mortar. True antifreezes, such as alcohols, may reduce the freezing point of the mortar, but they are not recommended.

Be sure to determine how other admixtures that are used affect cold weather construction. For example, coloring pigments may retard hydration.

If an accelerator is used to offset this effect, remember to check the admixtures' compatibility.

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TABLE 5-5: RECOMMENDATIONS FOR PLACING MORTAR IN COLD WEATHER

Minimum Workday Temperature	*Construction Requirements*	*Protection Requirements*
Above 40° F	Normal procedures	Cover walls with plastic or canvas at end of work day to prevent water entering masonry.
40° to 32° F	Heat mixing water to produce mortar temperatures between 40° F to 120° F.	Cover walls and materials to prevent wetting and freezing. Covers should be plastic or canvas.
32° to 25° F	Heat mixing water and sand to produce mortar temperatures between 40° F to 120° F	With wind velocities over 15 mph provide windbreaks during the workday and cover walls and materials at the end of the day to prevent wetting and freezing.
25° to 20° F.	Maintain mortar on boards above 40° F.	Maintain masonry above freezing for 16 hours using auxiliary heat or insulated blankets.
20 to 0° F.	Heat mixing water and sand to produce mortar temperatures between 40° F to 120° F.	Provide enclosures and supply sufficient heat to maintain masonry enclosures above 32° F for 24 hours.

Special masonry units are not required in cold weather construction either. Because moisture loss from the mortar to the atmosphere is slower during the winter months, brick with a slightly higher absorption rate may be laid. Bricks with extremely high rates of absorption, though, need to be sprinkled with warm or hot water just before laying.

Storing materials

All materials delivered to the job site must be carefully stored to prevent wetting by rain or snow. Most contractors place materials on planks and cover them with tarps. Sand should also be covered. If the weather is severe enough and the project large enough, erect a temporary shelter for material storage and mortar mixing.

Heating materials

When laying masonry in cold weather, always follow this rule: Keep the mortar temperature a minimum of 40° F. Table 1 lists the techniques for accomplishing this at different air temperatures. The easiest way is to heat the mix water. If the other materials are not frozen, this is all that has to be done. But some specifiers do not allow the water to be heated over 160°; they're afraid that it'll cause flash set of the cement. To avoid problems, add the heated water to the cold sand first, then add the cement. If this is done, even boiling water - though unsafe - can be used successfully sometimes.

At temperatures below 32° F, also heat the sand. Simply stockpile the sand over a heated pipe. The pipe can be heated by a portable heater or a fire can be built inside the pipe. Steam heating units also can be used. Heat the sand slowly and evenly to prevent scorching. To ensure uniform heating, mix the stockpile periodically. Scorched sand, which has a reddish hue, should not be used.

Once the mortar temperature has been selected, make every effort to make each batch of mortar at this temperature.

Masonry brick or block should be heated if their temperature falls below 20° F. Never use wet units after they've been frozen. Frozen units should be thawed first so they don't cool the mortar too quickly. There is no required method of heating masonry units. They can be placed in a heated enclosure or they can be stacked around heaters. In general, heating masonry units to 40° F is enough.

Table 5-6: RECOMMENDATIONS FOR PLACING GROUT IN COLD WEATHER

Minimum Workday Temperature	*Construction Requirements*	*Protection Requirements*
Above 32° F	Normal masonry procedures	Cover walls with plastic at end of workday to prevent water entering masonry.
32° F to 20° F	Heat grout materials to 90° F so grout has in-place temperature of 70° F at end of workday.	Cover walls with plastic or light ($1/4$ inch) insulation blanket to prevent rapid heat loss or water entering masonry.
20° F to 0° F	Heat grout materials to 90° F so grout has in-place temperature of 70° F at end of workday.	For grout that does not contain Type III cement: Cover walls with plastic or medium (1-inch) insulation blanket or maintain heated enclosure to 40° F for 2 days. For grout that contains Type III cement: Cover walls with plastic or medium (1-inch) insulation blanket or maintain heated enclosure at 40° F for 1 day.

Source "Recommended Practices & Guide Specifications for Cold Weather Masonry Construction".

Grout, like mortar, must also receive special cold weather attention. Placed in the hollowed masonry, grout is partially protected from the cold by the masonry block or brick. But because grout must be highly fluid to fill these hollows, it is made with a high water content that makes it expand much more than mortar when it freezes. As a result, grout materials should be heated and protected as described in Table 5-6 whenever freezing conditions may occur. Frozen grout can crack concrete masonry units and push clay brick units out of plane.

Protecting the wall

When air temperatures are above freezing, the newly constructed wall only has to be covered at the end of the workday to prevent water entry. Tables 5-5 and 5-6 show that when air temperatures are below freezing, extra precautions should be taken. Depending on how cold it is, wind screens, insulated blankets, temporary enclosures, or extra heat may be needed.

Some scaffold manufacturers make accessories for their scaffolds so the scaffolds can be enclosed with tarps or polyethylene.

Prefabricated enclosures or job-built enclosures made from polyethylene covered wooden frames can be used to enclose an entire construction area. Masons can construct several walls under the same heated enclosure, then the enclosure can be moved by crane.

A note about safety: Fossil-fuel burning heaters used to heat enclosures should be ventiliated to the outside or located outside the enclosure so that they blow hot air in. Fossil-fuel burning heaters produce carbon monoxide which can be deadly for workers.

Laying the masonry

During the cold weather, mix mortar in smaller amounts so it doesn't cool before it is used. Mortar can be placed on metal mortar boards with built-in electrical heaters, but do not let the heater dry the mortar. Place the masonry only on sound, unfrozen foundations. Never place it on a snow- or ice-covered surface. The snow or ice reduces bond and when it melts the masonry could shift.

Section VI: Tending The Mason

Page 68	Terms and Definitions
Page 69	Figure 6-1, *Mason Tools*
Page 70	Tending the Mason
Pages 71 - 73	*Bracing Masonry Walls: Why, When, Where, and How*

Trainee Section Objectives

1. Terms (Note, in this section it is important to recognize and identify all masons' tools):

Mudding down	Expansion joint material
Mortar board	Trowel/frog/spoon, etc.
Mortar pan	Twig/trig
Mortar stands	Line
Mortar tub	Line pin
Wire	Line block
Shape-up/tempering	Line stretcher/chicken leg
Strap anchors	Sled runner
Re-bar	S jointer
Wall-ties	V jointer
Perma-lite	4' level
Tempering can	2' level
Water bucket	Skate/raker
Hop-up/raise	Brick hammer
Mash hammer	Brick set
Pointing trowel	Stone chisel
Wire brush	Tuck pointers

2. Correctly describe the cleaning and wetting down of mortar boards and/or pans.

3. Describe the mudding down of mortar boards and/or pans.

4. Describe the procedures of tempering/shake-up of stiff mortar.

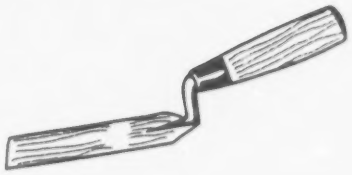
5. Describe your duties as a "Line Tender" in keeping the mason busy.

Terms and Definitions:

Mudding down	To place mortar on mortar boards or mortar pans.
Mortar board	A square wooden piece of 3/4"x30"x30" plywood on which mortar is placed for the mason's use. Also known as a mud board.
Mortar pan	A shallow, hard plastic or metal pan on which mortar is placed for the masons use.
Mortar board stand	A tubular metal folding stand hinged at the center. Used to support mortar boards and pans.
Mortar tub	A metal, rectangular 1'x3'x6' box used to transport mortar from the mixer to the work area. Also known as a mud tub.
Wire	Slang term for horizontal reinforcement wire. Also known as Duro-wall which is a brand name.
Shake-up	To temper add water to mortar which has begun to harden on the mortar boards or in the mortar tub.
Strap anchors	Reinforcement material used to attach partition walls to main walls.
Re-bar	Dowel-like iron rods of different sizes used to reinforce grout in the block cells.
Wall ties	Corrugated strips of metal used to hold masonry units to each other or to wooden walls.
Tempering can	Small, $\frac{1}{2}$ to 1 gallon cans used to dip water out of a 5 gallon pail when a small amount of water is needed for tempering mortar. An empty 2 or 3 pound coffee can is appropriate.
Water bucket	Holds water used by the mason tender for tempering mortar and for keeping shovel submerged in water so mortar will not dry up on it.
Perma-lite	A granular insulation material which is placed in the block cells.
Hop-up	A term meaning the raising of the mason's walk plank from one level to another.
Scaffold high	Means a mason can no longer lay brick or block because of the height of the wall and an addition of more scaffold must be used. Scaffold high is usually 4' to 4'8" vertically from where the mason is standing.

BRICK TROWELS

POINTING TROWELS



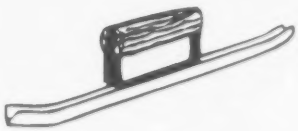
MARGIN TROWELS

TUCK POINTERS

BULLNOSE POINTING TROWELS

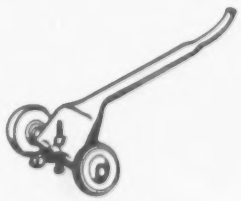
CHISEL

JOINTERS

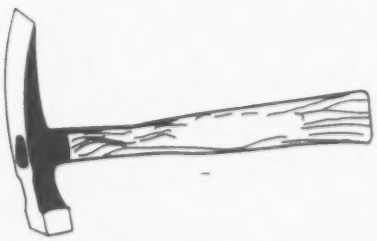


V JOINT

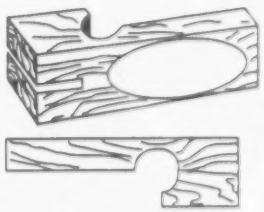
SLED RUNNERS



JOINT RAKER



BRICK HAMMER



WOOD LINE BLOCKS

MASON'S WOOD LEVEL

Figure 6-1
Mason's Tools

Tending The Mason

One of the most important jobs of the tender is to make sure that the mason does not run out of materials. The nature of masons is to work hard if his materials are close at hand, so do your part to make his work easier. When bricklayers yell at mason tenders, it is usually because they have to raise their voice to be heard over the noise of a construction job. Don't get your feelings hurt because you get yelled at; it's part of the job. There is always plenty of work to do. If you get behind, the masons will have to ask for materials to work with. If you get ahead, that time can always be used to clean up trash.

As material is used up on the front part of the scaffold, move the material from the back, within easy reach of the mason. Keep the masons supplied with special shapes or cuts as they need them. Save them as many steps as possible. The footplanks (front two planks) of the scaffold are where the mason usually works. Avoid standing or working in this area.

Wetting the boards

Wet the mortar boards before placing mortar on them. This will keep the mortar from drying out quickly. Begin by cleaning the boards. Use a short piece of re-bar, to beat on the boards to dislodge dry mortar from the previous use. Use a tempering can to wet the surface area of the board down so mix water from the mortar will not be absorbed by the board. When mortar is placed on the boards, be careful not to allow it to splash on other workers or on the walls. If possible, keep a small one gallon tempering can on each mortar board. Most bricklayers will help take care of their own mortar if water is close at hand.

Mudding down

Mudding down should begin at the wall corner boards then at the ones' in the middle of the wall. These are the places where the mason will start work on the wall. Corners are usually called "leads". The middle is where the "twig" will be placed. A mortar board will hold 3 to 4 shovelfuls.

Tempering the mortar

Tempering of mortar which has begun to harden on the boards involves the turning over and over of the mortar, adding small amounts of water to the mortar as it is being tempered to bring it back to desired consistency. Never use the mason's trowel to temper mortar. When tempering mortar, work the entire pile, not just the top; use a square pointed shovel and turn over the mortar that is on the bottom to the top side. Usually the board will absorb moisture from the mortar on the bottom, so mix this through the entire pile when tempering.

Duties of a line tender

The duties of a line tender involve keeping mortar on the boards, keeping stock supplies replenished, keeping "cuts" and special block on hand and keeping reinforcement material handy. Since everything is ready to go, the mason will never have to ask for materials.

Be careful about bumping into a mason, especially when he is working in an awkward or overbalanced position. Never use a masons' tools, especially the trowel, without asking for them.

Try to learn the habits of each mason you work with and cooperate with him or her as much as possible so materials are placed where it is most convenient for them.

Always plan ahead. Have a worksite ready for the masons when they finish the job they are on. Remember, there is nearly always an easier way to do things. Make your own job easier by finding out the proper way to do things and know that a team effort between laborers and masons will increase productivity.

Line tender equipment

Make sure you have:

hard hat
tempering cans
gloves
Duro-wall
tin snips
keel
water buckets
tape measure
short handled, square point shovel
long handled, square point shovel

Bracing Masonry Walls:

Why, When, Where, and How

by Bruce A. Suprenant
Department of Civil Engineering & Mechanics
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Almost all specifications make masonry contractors responsible for bracing walls under construction and liable for loss of property or life resulting from a wall collapse. And now, the Occupational Safety and Health Administration (OSHA) has tightened the liability noose around the contractors' neck. For the first time, OSHA lists specific requirements for bracing masonry walls under construction.

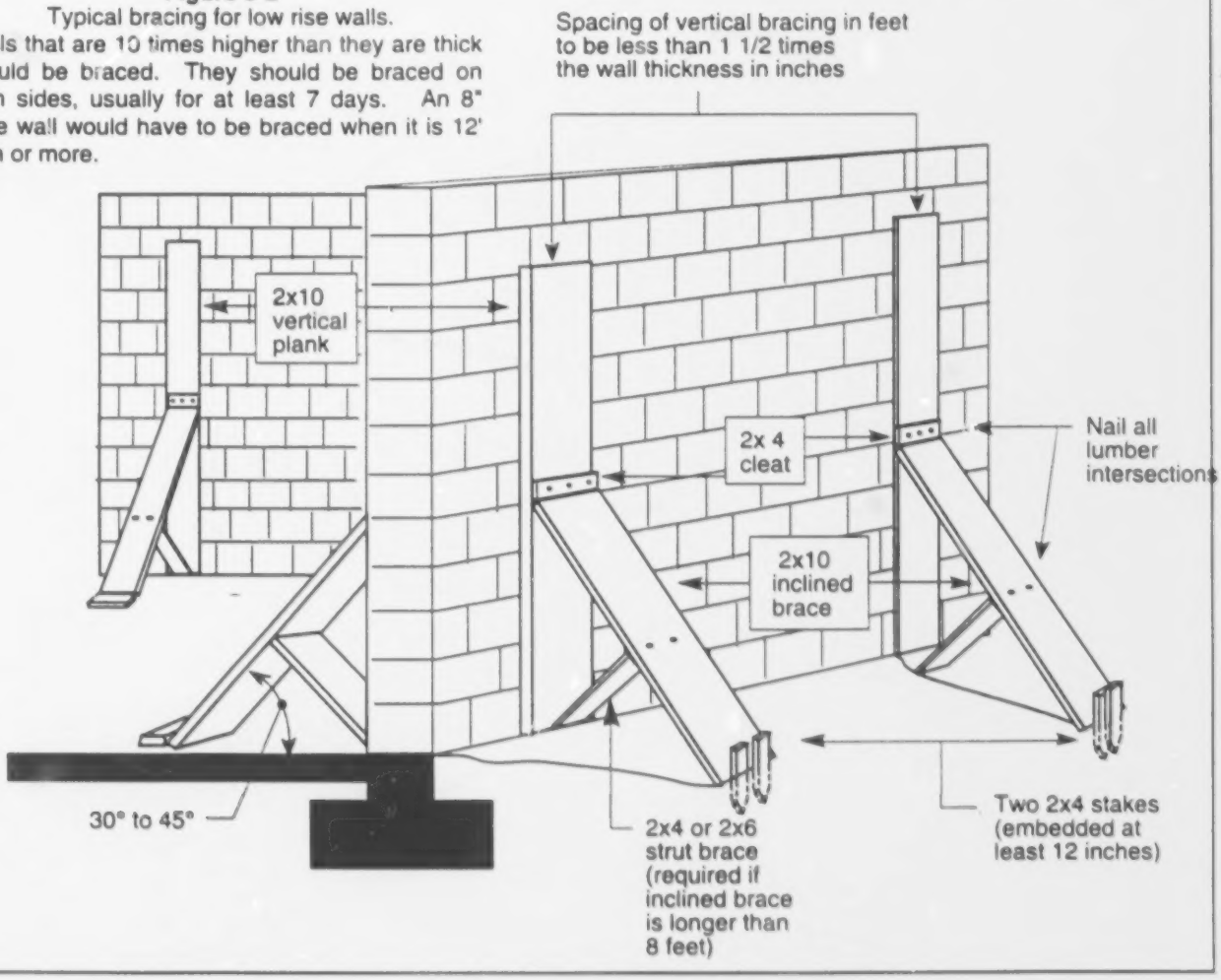
Why do walls fall down? The Mason Contractors Association of America (MCAA) reviewed 20 cases of wall failures from OSHA files (Ref. 1):

- In 11 cases, the walls were unbraced.
- In 5 cases, the bracing was removed too soon.
- In 4 other cases, the bracing was inadequate or poorly constructed.

Why brace?

A masonry wall that is under construction lacks the lateral support provided by intersecting roofs, floors, pilasters, and walls. It also takes

Figure 6-2
Typical bracing for low rise walls.
Walls that are 10 times higher than they are thick should be braced. They should be braced on both sides, usually for at least 7 days. An 8" wide wall would have to be braced when it is 12' high or more.


Spacing of vertical bracing in feet to be less than 1 1/2 times the wall thickness in inches
2x10 vertical plank
2x 4 cleat
Nail all lumber intersections
2x10 inclined brace
30° to 45°
2x4 or 2x6 strut brace (required if inclined brace is longer than 8 feet)
Two 2x4 stakes (embedded at least 12 inches)

time for the mortar to cure and the masonry wall to gain flexural strength. Until the mortar does gain adequate strength and floors and roof are installed, the wall usually must be braced. If it's not braced, even 20- to 30-mph winds can topple it.

When to brace

Figure 6-3 shows at what height concrete masonry walls must be braced, based on the design wind speed and the weight of the wall.

Most building codes recognize that wall bracing and other temporary support structures do not have to be designed for the greatest wind speed occurring in a 50 or 100 year period. Wall bracing is exposed to wind for only a short time. Although industry experts agree on that point, not all agree on what the design wind speed should be. Suggestions range from 40 to 80 mph (Ref. 1), but no U.S. national organization recommends a design wind speed for masonry wall bracing, nor do most local building officials.

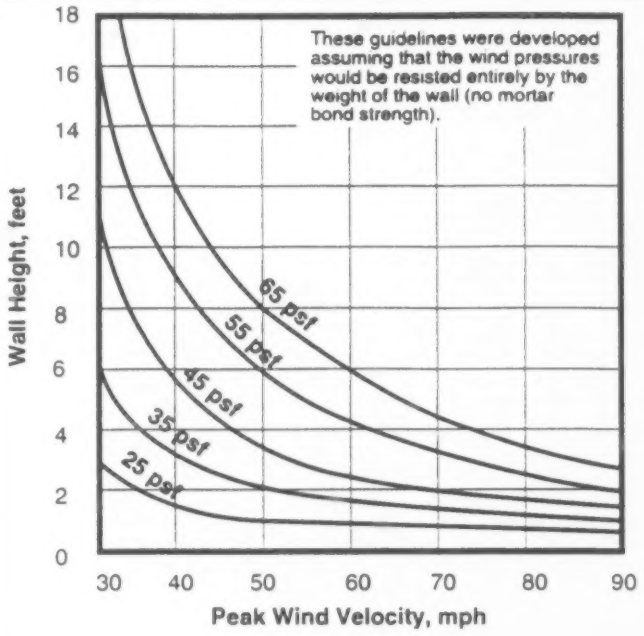


Figure 6-3

Based on the design wind speed and the weight of the wall, the maximum height of an unsupported masonry wall can be calculated. For example, an 8-inch-thick hollow block wall that weighs 45 pounds per square foot (psf) and must be able to withstand a 60-mph wind must be braced at heights over 3 feet. (Source: Ref. 4.)

The Australians, however, have selected the wind speed for a 5-year recurrence interval (also called 5-year mean returned period) as the design wind speed for temporary structures with a life of less than 6 months (Ref. 2). For most permanent structures, they base the design wind speed on a 50-year interval.

A wind speed for a 5-year recurrence interval is the maximum wind speed that occurs about once every 5 years. Design wind speeds for about 100 U.S. cities can be found in Reference 3. They usually range from 50 to 70 mph for most of the United States.

Note, too, that wind speeds (and thus wind pressures) vary with changing seasons. Contractors should use extra bracing during the season of high winds in their area.

Where to brace

If the lateral spacing of the bracing is too far apart, the wall may collapse in the section between the braces. Table 6-1 gives the maximum horizontal spacing of vertical bracing for hollow, non-reinforced concrete masonry walls subject to wind loads. For a wind speed near 70 mph, the spacing between, in feet, generally should not exceed 1 1/2 times the wall thickness, in inches.

How to construct bracing

For walls greater than 8 feet high, contractors should submit a bracing plan. A typical masonry wall brace includes a vertical member, an inclined strut, stakes, and if necessary, a strut-brace (see Figure 6-2). Scaffold planks (2x10's) are typically used for the vertical member and the inclined strut; 2x4's may be used for stakes and the strut-brace. Never use 2x4's or 2x6's for the vertical member or the inclined strut. Always make sure the lumber is in good condition.

Two 2x4's should be used as stakes. Do not use steel stakes, rebar, or 2x2's because they have less horizontal load-carrying capacity. Embed the 2x4 stakes at least 12 inches into the soil and preferably 18 inches.

TABLE 6-1: Maximum Horizontal Spacing Of Vertical Bracing Members

Nominal Wall Thickness, inches	Design Wind Speed, mph							
	30	40	50	60	70	80	90	100
6	19.0	15.5	12.0	10.0	8.7	7.8	6.8	6.2
8	25.0	20.4	15.8	13.4	11.5	10.2	9.0	8.1
10	30.4	24.8	19.2	16.3	14.0	12.4	10.9	9.9
12	35.3	28.8	22.3	18.9	16.2	14.4	12.7	11.5

Note: This table is for hollow, non-reinforced concrete masonry walls subject to uniformly distributed wind load with these and other assumptions: 1) wall height is equal to 30 feet or less; 2) simply supported spans; 3) walls built with Type M or S mortar and inspected workmanship. See Reference 4 for more details.

For inclined struts longer than 8 feet, provide a 2x4 brace. This increases the load-carrying capacity of the strut and helps prevent failure due to buckling at low loads. No recommendations have been found indicating the angle of the strut. It's common practice, however, to place the strut at a 30° to 45° angle.

Research work at the University of Michigan suggests that a horizontal strut at the base of the wall between the vertical plank and the stake can increase the load capacity of the bracing system (Ref. 5). The system's weak link is the nailed connections to this horizontal strut. Also, some jobsite conditions may make a horizontal strut impractical to build.

When to remove the bracing

When does the mortar gain enough strength to remove the temporary bracing? Unfortunately, the contractor is seldom given a good answer. The Brick Institute of America (BIA), however, has summarized the results of the increase in brick prism strength with time (Ref. 6). These results show that the strength at 3 days is 80% of the strength at 28 days, and at 7 days it's about 92% of the 28-day strength.

A reasonable assumption is that flexural strength increases with time at about the same rate as compressive strength. Therefore, after 7 days, the wall will reach most of its flexural design strength and may resist the applied wind loads without bracing. National Concrete Masonry Association (NCMA) recommends a bracing period from 3 to 7 days depending on the curing conditions. Hot or cold weather can accelerate or delay strength gain, thus shortening or extending the time before the bracing can be removed.

Depending on how the wall is braced, at a certain age it may be possible to remove half the bracing and use it elsewhere. The other half would remain until the wall could completely support itself. This frees a lot of lumber or rental products and reduces the contractor's cost. If, however, high winds are expected and permanent lateral bracing is not in place, leave the temporary bracing in place.

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Section VII: Housekeeping and Job Shutdown

Page 76 Terms and Definitions

Pages 77 -78 Housekeeping, Project Shutdown, and Equipment Maintenance

Trainee Section Objectives

1. To learn the definition of the following terms:

Housekeeping	Shutdown
Trash pile	Gang box
Culls	Tool shack

2. Competently describe and perform the mason tender's duties in relation to housekeeping.

3. Competently describe and perform the mason tender's duties in relation to job shutdown.

4. Competently describe and perform the mason tender's duties in relation to equipment maintenance.

Terms and Definitions

Housekeeping	Pick up and disposing of masonry rubble, and keeping the work area clean.
Trash pile	A designated place to dispose of all masonry related trash.
Culls	Masonry brick, block, or plank that can no longer be used.
Shutdown	To turn off all equipment and machinery and do maintenance checks on equipment. Gather all tools and equipment and store them properly.
Gang box	A large metal or wooden box used to store hand tools and small equipment.
Tool shack	Usually a trailer van used to store hand tools and larger equipment and machinery.

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Housekeeping

Try to keep the work area clean. There will always be trash and clutter around a construction job, but keep it under control; not only for reasons of appearance, but also for safety's sake. The following work habits will help you, your bricklayers, your employer, and the other trades on the job.

After the first course of masonry is laid, place sand on the floors before starting up with the walls. Don't let mortar fall on a concrete floor that has not been sanded, since it is much harder to clean up. Don't let mortar accumulate on floors, especially in the corners. If this is permitted, and the floors have not been sanded prior, a hammer and chisel may have to be used to clean the floor.

When throwing away mortar, dump it in small piles to make handling easier. A full wheelbarrow load is hard to dispose of, if it is allowed to harden in one pile.

During the day, keep your mortar shovels in a bucket of water or in a wheelbarrow of mortar so they won't dry out and require cleaning each time before use.

Keep the trash cleaned up as your job progresses. Continually separate good material from bad and put the good on the wall where it will be used up. If trash is allowed to accumulate it can create a hazard. Keep trash out from under the scaffold. Mortar spilled will pile up on this rubbish and make clean up even harder. Remember, you have to work there and it's hard to work around rubbish. Piling waste material on the scaffold can be a hazard. Keep the trash pile located in a convenient area where a front end loader can pick it up and put it in a dump truck.

Joint reinforcement left laying around will cause a tripping hazard as well as get bent and run over by forklifts or wheelbarrows. Keep all wall ties gathered up rather than allowing them to become scattered.

When doing masonry work over finished work below, such as sills, window frames, finished floors, etc., it may save hours of clean up work if you place a sheet of inexpensive plastic, poly, or paper over the work below. Covering the top of walls with the plastic, poly, or blankets, will keep debris and moisture from getting down inside the wall.

If you have a forklift on the job, keep leftover materials on pallets so they can be moved or stocked on the wall by the forklift.

Wind can often cause trash to blow and creates a problem with others living close to the construction site. A container to hold these bags can easily be made from a scrap piece of concrete reinforcing wire mesh.

Remember, you can make your own job easier by keeping the area picked up and clean.

Shutting Down the Job for the Day

Clean the saw daily. If it has been used much during the day, it will be full of sludge left from cutting bricks and blocks. If it is not cleaned, this sludge will plug up pumps and hoses. If this stops water from getting to the diamond blade, it will be ruined. These blades cost over $200.00 each. Completely clean the pump screen on the saw. Take the screen out, if necessary.

Clean all tools before putting them away. Mortar is easy to clean off while it is soft, but when it hardens, it will have to be chipped off with a hammer. Place left over mortar in small piles or on pallets for easy access to the forklift.

If possible, place tools in a locked tool shed or tool box. If none is available, cover them with a tarp. Make certain a tarp or plastic sheet is placed over the cement and lime. Rain and snow can easily ruin material overnight if not covered.

Ask the contractor to furnish a long chain and lock. This chain can be woven through the wheels of all of the wheelbarrows and two-wheeled brick buggies. When they are all locked together, they are very difficult to steal. Many times scaffold frames are stolen. However, if they are all chained and locked together this also makes theft very difficult.

The small amount of time necessary to put things away at the day's end will more than repay itself. If tools are stolen overnight, the entire masonry crew, including you, may miss valuable work time the next day until new tools are located.

In cold weather, always drain the water hose. A frozen hose in the morning can cause the crew to lose hours of work while it is being thawed out.

Equipment Maintenance

The machines and equipment used by today's mason contractors are often very complex and require specially trained personnel to operate them. The lack of some very basic maintenance can cause thousands of dollars in damage. The operation and maintenance of equipment such as forklifts and grout pumps will require special training of those responsible for their operation. If you are ever in doubt about the care of this equipment, make sure you ask your supervisor before doing anything.

There are, however, certain basic maintenance steps that are required on almost all types of equipment. Some of these things to check and maintain are:

- water level (and antifreeze in winter)
- gas level (check before starting machine, running out can cause costly delays)
- oil level (if low, add oil; if dirty, change)
- hydraulic fluid (keep full)
- grease fittings (Keep grease gun handy. If there are none available, ask the contractor to buy you one.)
- When adding water, oil, gas, or hydraulic fluid, make sure you are putting them in the right openings. The caps over these different holes should be clearly marked; if not, ask someone and then properly mark them.
- Know the limitations of the equipment you are working with. Don't pick up 3 tons of material with a forklift designed to raise only 1 ton. The forks may bend or break, the equipment may be ruined, and someone working nearby can be hurt or killed.

Take care of all equipment, even hand tools. Keep them clean. When they become damaged, fix them or set them aside and tell your foreman they need to be fixed. Don't continue to use something that will get worse and eventually hurt someone. Remember, small problems turn into big ones.

Don't borrow equipment or tools from other crews working on the job without their permission. When they loan their equipment, return it to them in the same or better condition.

After cleaning tools at the day's end, a thin coat of form oil or used motor oil can make cleaning them easier the next day. At the end of the day, gather up and account for all tools used during that day.

Glossary

Pages	82 - 90	Main Glossary
Page	91 - 92	Types Of Block
Page	93	Types Of Brick

GLOSSARY

Admix	Any material, other than water, aggregate and portland cement that is used as an ingredient of mortar and grout to improve the quality.
Adobe Brick	An unfired clay brick dried in the sun.
Aggregate	Particles like sand and gravel that bind together with portland cement and water to form concrete or mortar.
Anchor	A piece of metal or other material, that is used to attach masonry or masonry materials.
Anchor Ties	Any type of fastener used to secure masonry to some stable object, like a wall.
Angle	An inside corner.
Angle Iron	Iron that is molded at right angles; used to support masonry openings, like doors and windows.
Arch	A curved structural support that reinforces openings or recesses like doors and windows; also built flat.
Backup	That part of a masonry wall behind the exterior facing.
Bat	An end portion of a brick, approximately a half.
Batter	Stepping or sloping masonry back in successive courses; the opposite of corbel.
Bearing - Partition	An interior wall which supports any load in addition to its own weight.
Bearing Wall	A wall which supports a vertical load in addition to its own weight.
Bed	The horizontal surface on which the masonry units of the wall lie in courses.
Bed Joint	The horizontal mortar joint .
Bond	Tying the various parts of a masonry wall by lapping one unit over another. Also refers to the pattern formed by the exposed faces of the unit. The adhesion of the mortar and grout to the units is also referred to as "bond".
Basketweave Bond	Module groups of brick laid at right angles to those adjacent.
Bond Beam	Part of the masonry wall that can be reinforced horizontally. Rebar is the usual reinforcement material that fits into the u-shaped block called a bond beam block.
Bond Course	The course consisting of units which overlap more than one width of masonry.
Brick	A solid masonry unit of clay or shale, formed into a rectangle and burned or fired in a kiln.
Brick Buggy	A two-wheeled cart made especially for moving bundles of "100 packs" of brick.

Buttering	Placing mortar on a block or brick with a trowel.
Cap	The top of a wall or pier consisting of masonry units.
Cavity Wall	A wall that is two or more brick or block wide which is arranged to provide a continuous air space within the wall. The facing and backing (exposed part of the wall) are tied together with non-corrosive ties. (e.g. brick or wire.)
Cement	A burned mixture of clay and limestone crushed to a powder to make mortar, grout, or concrete.
Chase	A continuous hole or opening in a wall for pipes, ducts, etc.
Chimney	A shaft built to carry smoke away.
Chimney Lining	Fire clay, terra cotta, or refractory cement, used to build a chimney.
Chimney Throat	That part of a chimney directly above the fireplace where the walls are brought close together.
Clean Out Holes	Openings in first course of one wythe of brick wall, or cutouts in face shell of first course of block wall, for cleaning out mortar and droppings.
Collar Joint	The long vertical joint between two wythes of masonry.
Composite Wall	Wall that has different masonry on inside compared to the outside. (For example: block and brick, block and glazed structural units, etc).
Concave Joint	A mortar joint formed with a jointer that forms a smooth valley in the mortar. This type of mortar joint is weather resistant and inexpensive.
Concrete	A mixture of cement, sand, and gravel with water in varying proportions according to the use for which it is made.
Concrete Masonry Unit	Precast, hollow block or solid brick of concrete used in the construction of buildings.
Concrete Brick	A solid concrete masonry unit made from portland cement and suitable aggregates. It may or may not include other materials.
Coping	A covering or top for masonry walls, sometimes projected out from the wall to provide a decorative as well as protective feature.
Coping Brick	A solid concrete masonry unit for use as the top and finished course in wall construction.
Corbel	A shelf or ledge formed by projecting successive courses of masonry out from the face of the wall.
Core	A hollow space in blocks, bricks, or other masonry units.

Course	A continuous horizontal layer of block or brick that is bonded together with mortar.
Cross Joint	The joint between the two ends of the brick.
Culling	Sorting brick.
Curing	Maintaining proper moisture and temperature during initial set to increase strength and reduce shrinkage in concrete products.
Curtain Wall	A non-bearing wall built between columns or piers for the enclosure of a building, generally supported at each story.
Cut Joints	Masonry bed and head joints cut flush with trowel.
Dimension (Nominal)	Includes the actual dimensions of the a block, brick, or other masonry unit plus the thickness of the mortar.
Dog's Tooth	Brick laid so that their corners stick out from the face of the wall.
Dowels	Straight metal bars used to connect two sections of masonry; also, a two piece instrument for lifting stones.
Dry Pack	A mixture of cement and fine aggregate that is moist enough to cure properly but dry enough to ram into place.
Duro-O-Wall	See "joint reinforcement".
Efflorescence	Rain and snow will run down inside a wall if they are not covered. After the water evaporates, salts left behind leave a powder or stain (efflorescence) on the surface of the concrete.
Expansion Joint	A vertical joint or space to allow for movement due to volume changes.
Face	1. The exposed surface of a wall or masonry unit. 2. The surface of a unit designed to be exposed.
Face Shell	The side wall of a hollow concrete masonry or clay masonry unit.
Facing	Any masonry that forms the finished surface of a wall. (Not to be confused with Veneer, see definition.)
Fat Mortar	Mortar containing a high percentage of cementitious components. It is a sticky mortar which adheres to a trowel.
Fill Insulation	Small particles of insulation, usually in sacks that are poured down the interior of a masonry wall to make it more resistant to heat and cold.
Fire Box	The interior of a fireplace or furnace.

Fire Clay	Clay capable of being subjected to high temperature without fusing or softening noticeably. It is used extensively for laying of firebrick in the construction of kilns, ovens, and tanks for molten metals.
Fireplace	A hearth where some type of fuel is burned to heat a room or space.
Fireproofing	Any fire resistant matter use to cover other material to make it fire resistant.
Flagstone	A kind of stone that splits easily into slabs; also a term applied to irregular pieces of such stone split into slabs from one to three inches thick and used for walks and terraces, etc.
Flashing	A thin, waterproof material placed in mortar joints and through air spaces in masonry to prevent water penetration and/or provide water drainage. Generally made of sheet metal.
Flue Lining	A smooth hollow tile unit used for the inner lining of masonry chimneys.
Foot Plank	The plank placed on the outrigger for the masons to walk on to complete their work.
Foundation Wall	Part of the load bearing wall below grade or below the first floor beams or joints.
Frog	A depression in the bed surface of a brick. Sometimes called a panel.
Furring	A method of finishing the face of a masonry wall to provide space for insulation, prevent moisture transmittance, or to provide a surface for finishing.
Furrowing	The practice of striking a "V" shaped trough in a bed of mortar. Flattening out the mortar that the bricklayer spreads for a bed joint.
Glazed Structural	A solid or hollow unit with fired glazed surface.
Grout	A runny mixture of portland cement, aggregate, and water which is poured into hollow cells, or joints of the masonry walls, to bond steel and masonry block or brick together.
Hair Pin Block	A block that is closed at one end with the center web and the web at the other end left out. Intended to be laid around pipes in the wall, eliminating the need to make block cuts.
Harsh Mortar	A mortar that is difficult to spread (not workable).
Herring Bone Bond	In masonry, the arrangement of bricks in a course in a zigzag fashion, with the end of one brick laid at right angles against the side of a second brick.
Hod	A wooden or metal trough mounted on a pole, used to carry mortar or bricks.
Jamb	The side of an opening, like the ledge in a doorway or window.

Joint Reinforcement	Steel wire, bar, or prefabricated reinforcement which is placed in mortar bed joints.
Jointer	A tool used by bricklayers to form the various types of mortar joints between the courses of masonry. These mortar joints include concave, V, and weather joints.
Jointing	In masonry, the process of finishing the exterior surface of mortar joints between courses of masonry.
Joist Anchors	Anchors, usually steel straps, to secure joist or joist blocking to masonry walls.
Kiln Run	Brick or structural clay tile from one kiln which have not been sorted or graded for size, burning, or color variation.
Ladder Bar	A prefabricated, ladder shaped reinforcement, that is embedded in the horizontal mortar joints of masonry.
Lap	The distance one brick or reinforcing bar extends beyond or over another.
Lead	The section of a wall built up and racked back on successive courses at the end of a wall. A line is attached to leads as a guide for constructing a wall between them.
Lean Mortar	Mortar containing a low percentage of cementitious components (not workable).
Quick Lime	A lime that forms a chemical reaction when water is added to it. Use extreme caution when adding water.
Hydrated Lime	The dry powder that is formed when water is added to quick lime.
Slaked Lime	Same as hydrated lime.
Lime Putty	Putty-like hydrated lime that is ready to add to mortar.
Lintel	A beam placed over an opening in a wall.
Load Bearing Wall	Any wall which, in addition to supporting its own weight, supports the building above it.
Mason	A worker skilled in laying brick, block, or stone; as the bricklayer or stonemason.
Masonry	Brick, tile, stone, concrete block, etc., or combination thereof, bonded together with mortar.
Masonry Cement	A mill-mixed mortar cement for use in mortar.
Masonry Unit	Natural or manufactured building units of burned clay, concrete, stone, glass, gypsum, or other similar building units, or combination thereof, made to be bonded together by a cementitious agent.

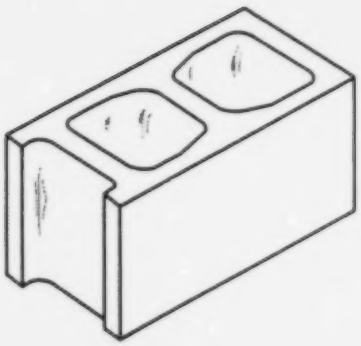
Miter	A cut made at an angle.
Modular Dimensional Standards	Dimensional standards approved by the American Standards Association for all building material and equipment, based upon a common unit of measure of four inches, known as the module. This module is used as a basis for the grid which is essential for dimensional coordination of two or more different materials.
Mortar	A plastic mixture of cementitious materials, fine aggregate, and water used to bind masonry or other structural units.
Mortar Box	A large metal box used to mix or hold mortar.
Mortar Bond	The adhesion of mortar to masonry units.
Mud	Slang for mortar.
Multi-Unit Wall	A wall that is two or more block or brick wide.
Nominal	A measurement that includes the actual dimensions of the block, brick or masonry unit plus the thickness of the mortar joint.
Ornamental Facing	In masonry, a design formed by the laying of stone, brick, tile or other masonry units to produce a decorative effect.
O.S.H.A.	Abbreviation for Occupational Safety and Health Administration. The federal agency responsible for implementation of many safety regulations.
Pier	An isolated column of masonry.
Pilaster	A portion of the wall that forms a vertical column or beam found on either or both sides of the wall.
Plasticizers	An agent added to mortar or grout mix to give it better workability.
Plumb Rule	Bricklayers, long level.
Pointing	Troweling mortar into a joint after masonry units are laid.
Pointing Trowel	A small hand tool used by stone masons or bricklayers for pointing up joints.
Popcorn	Slang for "fill insulation".
Prism testing of masonry	A section of wall approximately 16" high and 16" long of the thickness and type of construction similar to wall under construction.
Putlog	A timber or beam that is used as a support for a scaffold.
Racking	A method of stepping back each course of masonry as the wall is built. (The end of the wall will look like a set of stairs.)
Raggle	A groove in a joint or a special unit to receive roofing or flashing.
Railroad Track	Slang for joint reinforcing (see "joint reinforcing")

Random Rubble	Masonry wall built of unsquared stones, irregular in size and shape.
RBM	Reinforced Brick Masonry. (Brick hollows usually filled with grout)
Rebar	Steel dowels or bars of various sizes and shapes used to strengthen masonry.
Recess	An indentation in the surface of a wall.
Reglet	1. A groove or channel in a mortar joint, or in a special masonry unit, to receive roof flashing or other material which is to be sealed in the masonry. 2. A piece of sheet metal bent to fit the length of a mortar joint. Flashing is later inserted into this reglet.
Reinforced Masonry	Masonry that is reinforced with grout or some other material.
R.G.B.M.	Reinforced Grouted Brick Masonry, generally shortened to R.B.M.
Retempering	See Temper
Return	Any surface turned back from the face of a principal surface.
Reveal	That portion or jamb or recess which is visible from the face of a wall back to the frame placed between jambs.
Rowlock	A brick laid on its face edge so that the normal end of brick is visible in the wall face. Frequently spelled rolok. Sometimes called bull-headers.
Rubble	Rough broken stones or bricks used to fill in courses of walls or for other filling; also, rough broken stone direct from the quarry.
Running Bond	Lapping of units in successive courses so that the vertical head joints lap. Placing vertical mortar joints centered over the unit below is called center bond, or half bond, while lapping 1/3 or 1/4 is called third bond or quarter bond.
Sack Joint	Joint that has been wiped or rubbed with a rag or object such as a rubber heel.
Set	A change in mortar from soft to hard state.
Shake-up	See "temper-up".
Shiner	A brick laid inside out.
Shoved Joints	Vertical joints filled by shoving a brick against the next brick when it's being laid in a bed of mortar.
Sill High	The distance from the ground level to the window sill. In masonry, the height from the floor to masonry, the height from the floor to the sill.
Slurry Coat	A mixture of cement and water that forms a soupy solution that is usually brushed onto a surface. It primes the surface, allowing the mortar and masonry to stick to it.

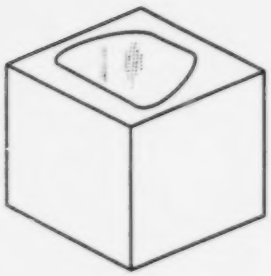
Slushed Joint	Vertical joints filled, after units are laid by "throwing" mortar in with the edge of a trowel. (Generally not good practice.)
Smoke Chamber	The space in a fireplace immediately above the throat where the smoke gathers before passing into the flue and narrowed by corbeling to the size of the flue lining above.
Soffit	The underside of a beam, lintel, or reveal.
Soap	A unit of the same face dimensions as a whole brick, but only one-half the thickness.
Soldier	A stretcher set on end with face showing on the wall surface.
Solar Screen Tile	Tile manufactured for masonry screen construction.
Spall	A small piece of masonry wall that has been chipped, cracked, or worn away.
Spandrel	That part of a panel wall above the top of a window in one story and below the sill of the window in the story above.
Splay	An inclined surface, as the slope or bevel at the sides of a door or window; also, to make a beveled surface, or to spread out or make oblique.
Split	A masonry unit half the height of a full unit.
Stack	Any structure or part thereof which contains a flue or flues for the discharge of gases.
Stacked Bond	A bonding pattern where no unit overlaps either the one above or below, all head joints form a continuous vertical line. Also called plumb joint bond, straight stack, jack bond, jack on jack, and checkerboard bond.
Story Pole	A marked pole for measuring masonry courses during construction.
Stretcher	A masonry unit laid with its greatest dimension horizontal and its face parallel to the wall face.
Stringing Mortar	The procedure of spreading enough mortar on a bed to lay several masonry units.
Struck Joint	In masonry, a mortar joint which is formed with a recess at the bottom of the joint. It is the reverse of the weathered joint. The struck joint is used extensively, but chiefly for interior wall surfaces, since it is inferior for outside joints, because of its lack of weather-resisting qualities. The recess at the bottom allows water from rain or snow to seep into the wall.
Temper	To moisten and remix to a proper consistency for use; also called retempering.
Temper Up	Same as "Temper".
Tender	A laborer who tends the needs of masons.
Throat	The part of a house chimney between the fireplace and the smoke chamber which contracts in ascending, and through which smoke rises from the hearth of combustion areas.
Tie	Any unit of material which connects masonry to masonry or other materials.

Tier	Each vertical section of masonry a single unit in thickness; also called withe or wythe.
Tooling	Compressing and shaping the face of a mortar joint with a special tool other than a trowel; also called jointing.
Top Out	To finish a wall.
Toothing	Constructing the temporary end of a wall with the end stretcher of every alternate course projecting. Projecting units are toothers.
Tuck Pointing	The filling in with fresh mortar of cut-out or defective mortar joints; in masonry, the filling of joints in old masonry with fresh mortar.
Twig	The bricks laid in the middle of a wall between the two main leads to overcome the sag in the line, and also to keep the center plumb in case there is a wind bearing upon the line. Also, the metal clip used to hold the mason's line.
Veneer	A single wythe of masonry for facing purposes, not considered as contributing to the structural value of the wall or surface.
Wall Tie	A bonder or metal piece which connects wythes of masonry to each other or to other materials.
Wall Tie, Cavity	A rigid, corrosion-resistant metal tie which bonds two wythes of a cavity wall. It is usually steel, 3/16 inch in diameter and forming a "Z" shape or rectangle.
Wall Tie, Veneer	A strip or piece of metal used to tie a facing veneer to the backing.
Weep Holes	Openings placed in mortar joints or retaining walls to permit water to escape.
Weeping Joints	When mortar is left to ooze out of the joints in a wall, leaving an informal rustic appearance.
Wire Cut Brick	A brick having its surfaces formed by wires cutting the clay before it is baked.
Wythe	1. Each continuous vertical section of masonry one unit in thickness. 2. The thickness of masonry separating flues in a chimney.

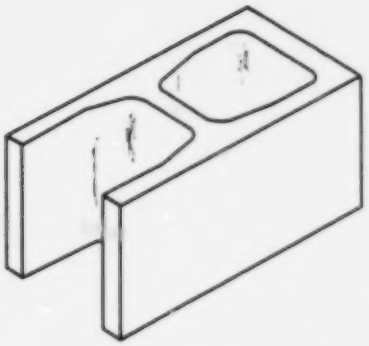
COMMON TYPES OF BLOCK



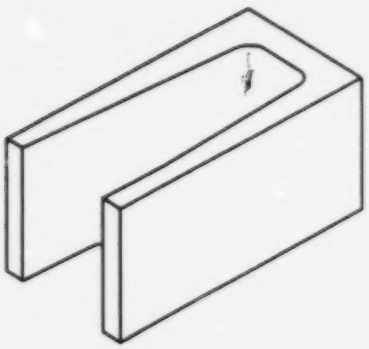
Standard



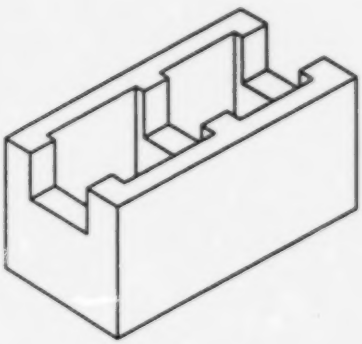
Half



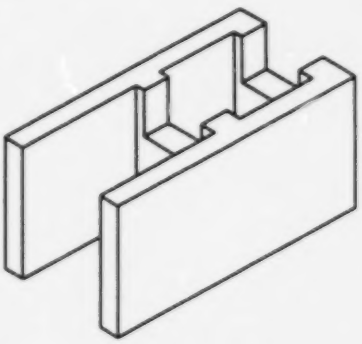
Open End



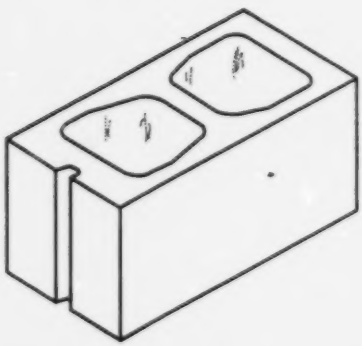
Hairpin



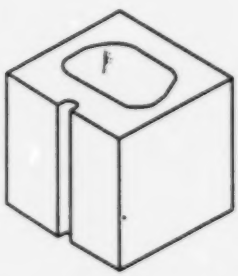
Bond Beam



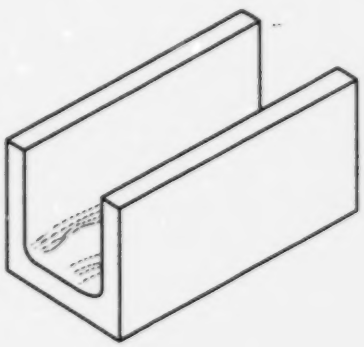
Open End Bond Beam



Sash

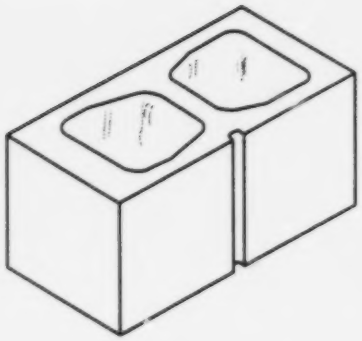


Half Sash

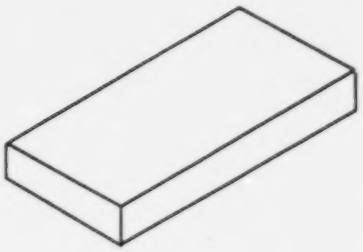


Lintel

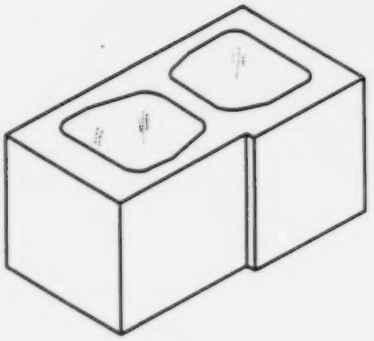
COMMON TYPES OF BLOCK



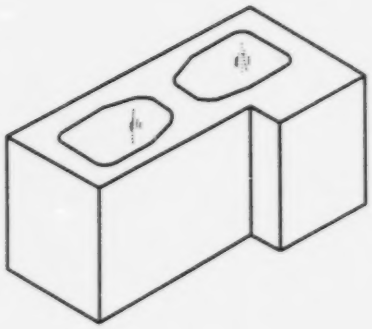
Center Scored



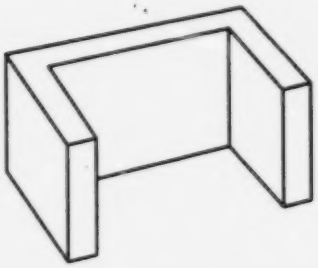
Cap



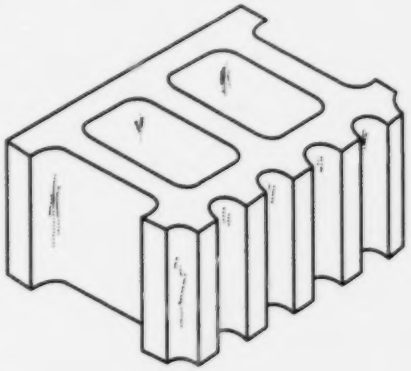
Offset



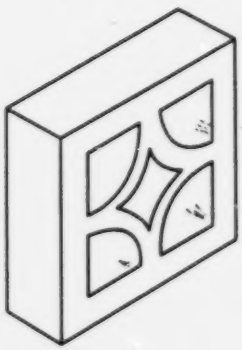
Corner



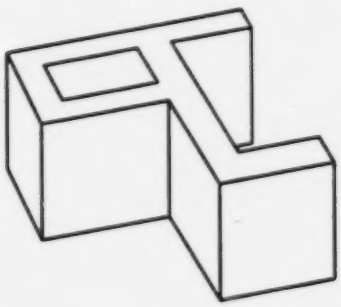
"C"



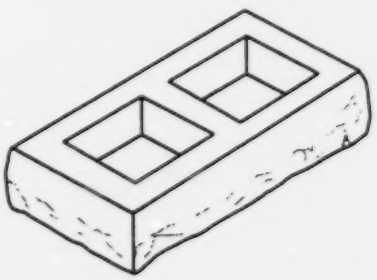
Fluted



Screen

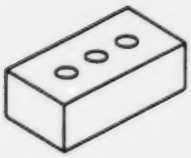


Banjo

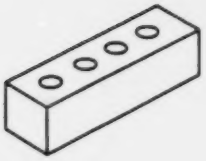


Slump

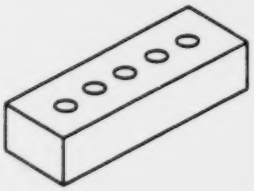
COMMON TYPES OF BRICK



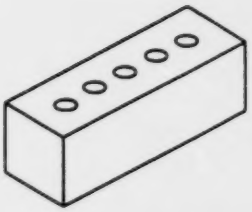
Regular Brick
4"x2-5/8"x8"



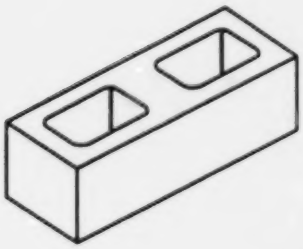
King Brick
3"x3"x10"



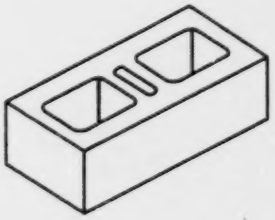
Norman Brick
4"x2-5/8"x12"



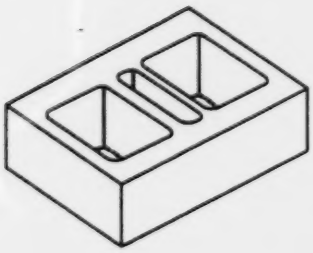
Jumbo Brick
4"x4"x12"



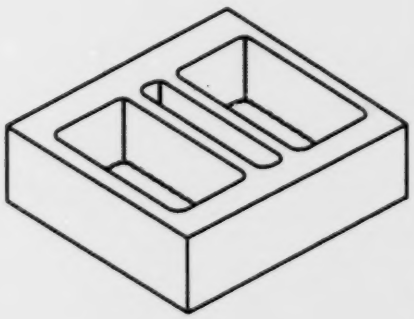
Uniwall Brick
4"x4"x12"



Uniwall Brick
6"x4"x12"



Uniwall Brick
8"x4"x12"



Uniwall Brick
10"x4"x12"

LABORERS-AGC
EDUCATION AND TRAINING FUND

MASON TENDING II

Instructor Manual

Laborers-AGC Education and Training Fund
37 Deerfield Road
Pomfret Center, Ct. 06259

Version 8/91

Mason Tending II

Course Outline

Section I: Introduction

Section II: Safety

Section III: Rough Terrain Forklift Operation

Section IV: Masonry Saw Operation

Section V: Mortar, Grout, and Additives

Section VI: Masonry Reinforcement

Section VII: Advanced Scaffolding Techniques

Section VIII: Enclosing Masonry Projects

Mason Tending II

Course Schedule

Time	Description	Minutes In Class	Minutes In Field
Day One			
7:00 to 8:30	Section I:		
	Introduction	30 min.	
	Course Objectives	30 min.	
	Site Walk-Thru		30 min.
8:30 to 10:00	Section II:		
	Safety	90 min.	
10:00 to 2:30	Section III:		
	MCAA Manual	180 min.	
	Instructor Forklift Demonstration		60 min.
2:30 to 3:00	Section IV:		
	Instructor Demonstration on Masonry Saw		30 min.
3:00 to 3:30	Section IV:		
	Instructor Presentation on Masonry Saw	30 min.	
3:30 to 5:30	Section V:		
	Instructor Presentation		
	Mortar, Grout, & Additives	120 min.	
Day Two			
7:00 to 9:00	Section VI:		
	Instructor Presentation		
	Masonry Reinforcement	120 min.	
9:00 to 10:00	Section VII:		
	Instructor Presentation		
	Advanced Scaffolding	60 min.	
10:00 to 10:30	Section VIII:		
	Instructor Presentation		
	Enclosing Masonry Projects	30 min.	
10:30 to 12:00	Section VII:		
	Instructor Demonstration of Step Scaffolding		60 min.
	Instructor Review of Exercises		30 min.

Course Schedule

Time	Description	Minutes In Class	Minutes In Field
12:30 to 2:30	Hands-On Exercises:		
	Forklift		2 Hours
	Masonry Saw		2 Hours
	Mortar, Grout, and Additive Mixing		2 Hours
	Advanced Stocking		2 Hours
2:30 to 4:30	Rotate Hands-On Exercises:		
	Forklift		2 Hours
	Masonry Saw		2 Hours
	Mortar, Grout, and Additive Mixing		2 Hours
	Advanced Stocking		2 Hours
4:30 to 5:30	Rotate Hands-On Exercises:		
	Forklift		1 Hour
	Masonry Saw		1 Hour
	Mortar, Grout, and Additive Mixing		1 Hour
	Advanced Stocking		1 Hour
Day Three			
7:00 to 8:00	Complete 3rd Rotation:		
	Forklift		1 Hour
	Masonry Saw		1 Hour
	Mortar, Grout, and Additive Mixing		1 Hour
	Advanced Stocking		1 Hour
8:00 to 10:00	Complete Hands-On Exercises:		
	Forklift		2 Hours
	Masonry Saw		2 Hours
	Mortar, Grout, and Additive Mixing		2 Hours
	Advanced Stocking		2 Hours
10:00 to 12:00	Section 7:		
	Instructor Demonstration		2 Hours
	Circular Scaffolding with		
	Tube & Clamp and Frame Scaffolding		
12:30 to 3:30	Hands-On Exercises:		
	Forklift		3 Hours
	Step Scaffolding		3 Hours
	Outside Radius Scaffolding with Frame		3 Hours
	Inside Radius Scaffolding with Tube & Clamp		3 Hours

Mason Tending II

Course Schedule

Time	Description	Minutes In Class	Minutes In Field
3:30 to 5:30	Rotate Hands-On Exercises:		
	Forklift		2 Hours
	Step Scaffolding		2 Hours
	Outside Radius Scaffolding with Frame		2 Hours
	Inside Radius Scaffolding with Tube & Clamp		2 Hours
Day Four			
7:00 to 8:00	Complete 2nd rotation Hands-on:		
	Forklift		1 Hour
	Step Scaffolding		1 Hour
	Outside Radius Scaffolding with Frame		1 Hour
	Inside Radius Scaffolding with Tube & Clamp		1 Hour
8:00 to 11:00	Rotate Hands-On Exercises:		
	Forklift		3 Hours
	Step Scaffolding		3 Hours
	Outside Radius Scaffolding with Frame		3 Hours
	Inside Radius Scaffolding with Tube & Clamp		3 Hours
11:00 to 2:30	Complete Hands-On Exercises:		
	Forklift		3 Hours
	Step Scaffolding		3 Hours
	Outside Radius Scaffolding with Frame		3 Hours
	Inside Radius Scaffolding with Tube & Clamp		3 Hours
2:30 to 5:30	Wrap Up:		
	Site Clean-up		
	Review		
	Forklift Examination		
	Evaluations		

Mason Tending II: Equipment & Material List

Box Frame Scaffolding		
3' Box Frames	-	4 ea.
Cross Braces	-	4 ea. (for 3' box frames)
4' Box Frames	-	4 ea.
Cross Braces	-	4 ea. (for 4' box frames)
5' Box Frames	-	16 ea.
6'-6" Box Frames	-	6 ea.
Cross Braces	-	16 ea. (for standard 5' or 6'-6" box frames)
Outriggers	-	16 ea.
Scaffold Plank	-	190 ea. (8', 9', or 10' fit to cross brace span)
Guard Rail Posts	-	16 ea.
Guard Rails	-	32 ea.
Screw Jacks	-	40 ea.
Tube and Coupler Scaffolding		
6' tube/tubelok	-	4 ea.
8' tube/tubelok	-	11 ea.
12' tube/tubelok	-	12 ea.
13' tube/tubelok	-	8 ea.
Base Plates	-	10 ea.
Screwjacks	-	10 ea. (designed for tube scaffold ordered)
2" x 2" Right Angle Clamps	-	122 ea.
2" x 2" Swivel Clamps	-	6 ea.
1 5/8" x 2" Right Angle Clamps	-	64 ea.
Materials		
Accelerator	-	Non Cloride
Coloring	-	2 colors
Retarder	-	Don't get any on you (you will never be the same again)
Masonry Cement	-	4 bags
Plasticizer	-	Mix with grout
Flashing	-	Samples to use in stocking exercise
Control Joint	-	a couple pieces
Dur-a-wall	-	1 bundle for 8" block
Rebar	-	5 ea. 20' #4
Rebar	-	15 ea. 20' #5
Wall Ties	-	Several examples of every type you can get your hands on
Muriatic Acid	-	1 gallon
Extra Pallets	-	6 ea

Mason Tending II: Equipment & Material List Continued

Tools and Equipment

1	-	Telescoping Boom Forklift (Lull, Skytrack etc.)
1	-	Masonry Saw
5	-	Mortar Boards and Stands
1	-	All-Purpose Saw with metal and masonry blades
4	-	Long Handle brushes for brick or block cleaning
1	-	Mortar Mixer
2	-	Brick Tongs
4	-	Torpedo Levels
2	-	4' levels
4	-	Scaffold Ratchets

Personal Protective Equipment

2 sets	-	Rubber Boots, Gloves and Aprons for Sawing
8	-	Gloves
8	-	Safety Glasses
8 sets	-	Ear Plugs
2	-	Respirators for dry cutting

Mason Tending II: Instructor Outline

Section I: Orientation

A. Introduction

Instructor's Objectives:

(1) To identify himself and the participants in the program by name, local union, employer, level of experience.

Presentation:

(1) Identify yourself by name, local union, employer, level of experience.

(2) Ask each trainee to offer the same information.

(3) Have each trainee fill out an application or course registration form, if one is used.

B. Course Objectives, Outline, and Materials

Instructor's Objectives:

(1) To review the objectives, outline and materials used in the course with the trainees.

Presentation:

(1) Ask the class to review the objectives/outline and ask the trainee to spend a few minutes reviewing the documents.

(2) Review and comment on any questions on the course objectives.

C. Walk Through The Mason Tending Training Area

Instructor's Objectives:

(1) To familiarize trainees with the work area.

Presentation:

(1) Instructor leads trainees through the work area, briefly explaining materials and equipment. Show trainees the storage location of tools and equipment.

Section II: Safety

(1) Instructor conduct a general safety discussion on all topics covered in the course including:

a. Forklift
b. Scaffolding
c. Masonry Saw
d. Reinforcing Materials
e. Enclosures

During this discussion review and highlight the applicable safety standards for each of the items listed above.

(2) Instructor review the Material Safety Data Sheets in the trainee manual covering the chemicals and materials used in masonry construction.

Section III: Rough Terrain Forklift Operation

A. Forklift Safety

Instructor's Note: There are many types of forkifts in use on masonry projects. Each of these forklifts have differences in their design and operation. It is essential for you, as an Instructor, to fully read and understand the manufacturers' operation manual. The manual will explain the entire machine, its operation and its specific maintenance requirements.

Instructor's Objectives:

(1) To instruct trainees on the safe and proper operation of forklifts.

Presentation:

(1) Instructor hands out MCAA Rough-Terrain Fork-Lift Manual.

(2) Instructor indicate that the trainees will be tested on the material in the manual and that a competency rating of 80% will be required to receive the safe fork-lift operation card. The required 80% score will be a combination of written score and demonstration of competency during the hands-on exercises.

(3) Ask the class to read and complete the review questions in sections 1-3. (pages 1 through 26 in the MCAA manual).

(4) Monitor the progress of the trainees and offer help where needed.

(5) Assign the remainder of the MCAA manual as homework for Day 1.

B. Hands-On Fork-lift Demonstrations

Instructor's Objectives:

(1) To demonstrate to the entire class the correct procedure to:

i. Perform a pre-start maintenance check.
ii. Operate the engine and transmission.
iii. Operate the forks.
iv. Operate other equipment specific features (such as hydraulic leveler or boom extender).
v. Shut down.
vi. Perform a post-shut down maintenance check.

(2) To warn the trainees about any equipment specific hazards such as pinch points and lift limits.

(3) To instruct the class in safe load lifting and carrying procedures.

Section III: Rough Terrain Forklift Operation Continued

Presentation:

(1) Take the class out to the fork lift(s) and demonstrate the pre-start maintenance check. Explain the following procedures while you are demonstrating:

a. Inspect the fan belts. Check for worn or loose condition.

b. Inspect the tire condition. Check for low air or excessively worn tread.

c. Inspect the forks. Check that connecting bolts or pins are in good condition, check that the forks are located correctly on the sliding bar and that both are all the way down against the frame.

d. Inspect the fluid levels including:

i. Fuel
ii. Engine Oil
iii. Hydraulic Fluid
iv. Power Steering Fluid

(2) Explain the engine and transmission controls including:

a. The location of the clutch, brakes, throttle, choke, steering controls, and transmission shift pattern.

(3) Explain the lift controls and equipment specific controls including:

a. The location of the lift, tilt, extend, or shift controls.

b. Any equipment attachment controls.

Instructor's Note: Explain what <u>every</u> control lever or mechanism does.

(4) Demonstrate the starting procedure and start the engine.

(5) Demonstrate the operation of each of the controls.

(6) Demonstrate the shut down procedure and stop the engine.

(7) Show the class the locations of any pinch points or other equipment specific hazards.

(8) Show the class the location of any lift limit charts located on the fork lift.

(9) Explain to the class safe load lifting and transporting procedures including:

a. Never exceed the equipment load limits.

b. Forks should be set at the maximum width for the load to be lifted.

Section III: Rough Terrain Forklift Operation Continued

c. Forks should be straight and level.

d. Forks should be fully inserted until load is against the back rest.

e. When transporting materials, forks should be tilted backwards slightly. The load should be lifted only high enough to clear obstructions on the ground.

f. If the load obstructs visibility, transport the load in reverse.

g. Always be aware of the ground conditions, obstructions in your path, people and other equipment.

h. When lifting, be aware of overhead obstructions and conditions.

i. When placing the load, get as close to the placement area as possible.

j. Never turn the wheel while the load is elevated.

k. Follow hand signals whenever someone else is guiding you.

Instructor's Note: Use a simple obstacle course for the first exercise. This will help to demonstrate normal project conditions and will help build trainee confidence.

(10) Review the common hand signals used with a forklift.

(11) Begin the hands-on exercises.

Section IV: Masonry Saw Operation and Maintenance

A. Masonry Saw Safety

Instructor's Objectives:

(1) To instruct trainees on the safe and proper operation of Masonry Saws.

Presentation:

(1) Ask the class to read section 4 in the trainee manual.

(2) Instructor review the safety features applicable to the masonry saw including:

a. Personal protective equipment
b. Electrical hazard
c. Slipping hazards

B. Masonry Saw Operation

(1) Instructor review the different types of saws used in masonry work including:

a. A portable all purpose saw.
b. A stationary saw.
c. A table saw.

(2) Instructor review the different types of blades used in masonry work including:

a. Wet cutting blades
b. Dry cutting blades
c. Carborundum blades

C. Hands-On Masonry Saw Demonstrations

Instructor's Objectives:

(1) To train the class in the safe start up and operation of the Masonry Saw.

Presentation:

(1) Instructor take the class to the masonry saw(s) and demonstrate the correct procedure to perform a pre-start check including:

a. Blade and blade mounting
b. Electrical supply and grounding in-place and working
c. Work area clear of slipping and tripping hazards
d. PPE
e. Set-up of material and waste areas

(2) Instructor demonstrate the proper procedure to cut block and bricks including:

a. Rip guide and alignment set up
b. Water adjustment
c. Proper feed pressure
d. Hand placement

Section V: Mortar, Grout and Additives

Instructor's Objectives:

(1) To train the class in the proper uses and applications of mortar and grout admixtures.

(2) To train the class in proper masonry cleaning techniques.

Presentation:

(1) Instructor ask the class to read the sections concerning admixes in the trainee manual.

(2) Instructor review the key points in the manual including:

- a. Mortar types
- b. Mortar problems
- c. Mortar admixtures
  - i. Air-entraining agents
  - ii. Accelerators
  - iii. Retarders
  - iv. Bond modifiers
  - v. Corrosion modifiers
  - vi. Water repellents
  - vii. Proprietary plasticizers
  - viii. Colors
- d. Mortar silo systems
- e. Mobile batcher-mixer trucks
- f. Continuous mixers

(3) Instructor ask the class to read the section covering grout in the trainee manual.

(4) Instructor review the key points in the manual including:

- a. Proportions
- b. Admixtures
  - i. Air-entrainment
  - ii. Plasticizers
- c. Uses
- d. Placement

(5) Instructor ask the class to read the section covering cleaning new masonry in the trainee manual.

(6) Instructor review the key points including:

- a. Bucket and brush hand cleaning
- b. High pressure water cleaning
- c. Sandblasting

Section VI: Masonry Reinforcement

Instructor's Objectives:

(1) To train the class in the recognition and stocking of masonry reinforcement materials.

Presentation:

(1) Instructor ask the class to read the sections concerning masonry reinforcement in the trainee manual.

(2) Instructor review the key points in the manual including:

a. Joint reinforcement and control joints
b. 4 types of reinforced masonry walls
c. Reinforcement for columns and pilasters
d. Reinforcement for bond beams and lintels
e. Wall ties, flashing and insulation

Section VII: Advanced Scaffolding

Instructor's Objectives:

(1) To train the class in the proper procedure to erect scaffolding on irregular terrain and for irregular shaped projects.

Presentation:

(1) Instructor ask the class to read the sections concerning scaffolding erection in the trainee manual.

(2) Instructor review the key points in the manual including:

a. Set-up and use of tubular welded frame scaffolding
b. Set-up and use of tube and clamp scaffolding

Section VIII: Enclosing Masonry Projects

Instructor's Objectives:

(1) To train the class in the proper procedure to protect masonry projects during adverse weather conditions.

Presentation:

(1) Instructor ask the class to read the sections concerning constructing and heating enclosures in the trainee manual.

(2) Instructor review the key points in the manual including:

a. Cold weather practices
b. Construction of enclosures
c. Heating enclosures
d. Storage and heating of materials

LABORERS-AGC
EDUCATION AND TRAINING FUND

MASON TENDING II

Trainee Manual

Laborers-AGC Education and Training Fund
37 Deerfield Road
Pomfret Center, Ct. 06259

Version 8/91

Mason Tending II

Course Outline

Section I: Safety

Section II: Rough Terrain Forklift Operation

Section III: Masonry Saw Operation

Section IV: Mortar, Grout, and Additives

Section V: Masonry Reinforcement

Section VI: Advanced Scaffolding Techniques

Section I: Safety

Page 3 to 12 Material Safety Data Sheets

Trainee Section Objectives

A. To become familiar with the hazards associated with operating a forklift.

B. To review the Material Safety Data Sheets covering materials used in masonry work.

C. To become aware of the applicable U.S. OSHA safety standards involved in motor vehicle operation, material handling, and tube and coupler scaffolding.

Material Safety Data Sheet
May be used to comply with
OSHA's Hazard Communication Standard
29 CFR 1910.1200. Standard must be consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administraion
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

Identity (As Used on Label and List)	**Note: Blank spaces are not permitted, if any item is not applicable, or no information is available, the space must be marked to indicate that.**
CALCIUM CHRLORIDE FLAKE 77/80%	

Section I

Manufacturer's Name	**Emergency Telephone Number**
DI-EL CHEMICALS, INC	201-729-8380
Address (Number, Street, City, State and ZIP Code)	**Telephone Number for Information**
25 VALLEY RD.	201-729-8380
SPARTA, N.J. 07871	**Date Prepared**
	3/25/87
	Signature of Preparer (optional)
	NA

Section II - Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	**OSHA PEL**	**ACGIH TLV Recommended**	**Other Limits**	**%(optional)**
CALCIUM CHLORIDE, DIHYDRATE	NA	NA	NA	77/80%
CAS. NO. 10035-04-8				

Section III - Physical/Chemical Characteristics

Boiling Point	NA	**Specific Gravity (H_2O = 1)**	0.84
Vapor Pressure (mm Hg)	NA	**Melting Point**	176 DEG C 349 DEG F
Vapor Density (AIR = 1)	NA	**Evaporation Rate (Butyl Acetate = 1)**	N/A

Solubility in Water COMPLETE IN ALL PROPORTIONS

Appearance and Odor ODORLESS SMALL WHITE FLAKES

Section IV - Fire and Explosion Hazard Data

Flash Point (Method Used) NA	**Flammable Limits** NA	**LEL** NA	**UEL** NA

Extinguishing Media USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE

Special Fire Fighting Procedures FIRE FIGHTERS SHOULD WEAR PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE

Unusual Fire and Explosion Hazards TOXIC GASES PRODUCED...HYDROGEN CHLORIDE

(Reproduce locally) **OSHA 174, Sept. 1985**

Section V - Reactivity Data

Stability	**Unstable**		**Conditions to Avoid** MOISTER
	Stable	XX	

Incompatibility (Materials to Avoid MOST COMMON METALS, WATER DECOMPOSITION PRODUCTS...HYDROGEN CHLORIDE HAZARDOUS POLYMERIZATION WILL NOT OCCUR

Hazardous Decomposition or Byproducts
HYDROGEN CHLORIDE POLYMERIZATION WILL NOT ODDUR

Hazardous	**May Occur**	NA	**Conditions to Avoid** NA
Polymerization	**Will Not Occur**	XX	NA

Section VI - Health Hazard Data

Route(s) of Entry:	**Inhalation?**	**Skin?**	**Ingestion?**
	Avoid: Wear respirator	Avoid: Wear gloves	Avoid

Health Hazards (Acute and Chronic)
NA

Carcinogenicity:	**NTP?**	**IARC Monographs?**	**OSHA Regulated?**
NA			

Signs and Symptoms of Exposure CONTACT WITH SKIN OR EYES MAY CAUSE SEVERE IRRITATION OR BURNS. INGESTION MAY CAUSE NAUSEA AND VOMITING. DUST MAY IRRITATE NOSE AND THROAT.

Medical Conditions
Generally Aggravated by Exposure NA

Emergency and First Aid Procedures SKIN: wash thoroughly and remove contaminated clothing. EYES: flush with cool water for 15 minutes and get medical attention. INHALATION: induce vomiting and call a physician.

Section VII - Precautions for Safe Handling and Use

Steps to Be Taken in Case Material is Released or Spilled WEAR SELF CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING. WITH CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER. REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER.

Waste Disposal Method
DISPOSE IN ACCORDANCE WITH APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS

Precautions to Be Taken in Handling and Storing VENTILATION...USE ADEQUATE GENERAL OR LOCAL EXHAUST VENTILATION TO KEEP FUME AND DUST LEVELS AS LOW AS POSSIBLE. RESPIRATORY PROTECTION ...NONE REQUIRED WHERE ADEQUATE VENTILATION CONDITIONS EXIST. IF AIRBORNE CONCENTRATION IS

Other Precautions
HIGH, USE AN APPROPRIATE RESPIRATOR OR DUST MASK. EYE/SKIN PROTECTION...SAFETY GLASSES WITH SIDE SHIELDS, UNIFORM, RUBBER GLOVES ARE RECOMMENDED.

Section VII - Control Measures

Respiratory Protection (Specify Type)
Use a NIOSH certified respirator.

Ventilation	**Local Exhaust**	**Special**
	GENERALLY ADEQUATE	NA
	Mechanical (General)	**Other**
	AS NEEDED	NA

Protective Gloves	**Eye Protection**
RUBBER	SAFETY GLASSES WITH SIDESHIELDS

Other Protective Clothing or Equipment
LAB COAT, RESPIRATOR IF DUST IN AIR BECOMES EXCESSIVE

Work/Hygienic Practices
KEEP CONTAINER TIGHTLY CLOSED. SUITABLE FOR GENERAL CHEMICAL STORAGE AREA.

DI-EL CHEMICALS, INC.

P.O. BOX 187, LAFAYETTE, N.J. 07848

(201) 579-7005
(201) 579-7002 FAX

STANDARD SPECIFICATIONS

CALCIUM CHLORIDE 77 - 80% FLAKE

CHEMICAL ANALYSIS:	TYPICAL	
$CaCl^2$	79.4	%
Total Alk. Ch. (NaCl)	1.4	%
$Ca(OH)^2$	0.082	%
$MgCl^1$	0.49	%
Mg + Alk. Salts	1.4	%
Other Impurities *	0.4	%
Heavy Metals (AS PB)	LESS 20.0	PPM
PB	LESS 0.5	PPM
AS	0.03	%
F	1.6	%

* 100 - ($CaCl^2$% + NaCl% + KCl% + $MgCl^2$% + H^20 + $Ca(OH)^2$%)

This meets the following specifications:
ASTM D 90-80 and AASHTO

PACKAGING:

- In 25, 50 and 100 pound bags
- All packages are on pallets and shrinkwrapped

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Material Safety Data Sheet
May be used to comply with
OSHA's Hazard Communication Standard
29 CFR 1910.1200. Standard must be consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administraion
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

Identity (As Used on Label and List)	**Note: Blank spaces are not permitted, if any item is not applicable, or no information is available, the space must be marked to indicate that.**
BRICK & MASONRY CLEANER	

Section I

Manufacturer's Name	**Emergency Telephone Number**
Ecological & Specialty Products, Inc.	201-208-0023
Address (Number, Street, City, State and ZIP Code)	**Telephone Number for Information**
413 Jelsma Place (Box 451, River St. Sta.)	201-208-0023
	Date Prepared
Patterson, N.J.	9/1/87
	Signature of Preparer (optional)
07524	

Section II - Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	**OSHA PEL**	**ACGIH TLV Recommended**	**Other Limits**	**%(optional)**
Hydrochloric Acid (CAS 7647-01-0)	5PPM	5PPM		
Phosphoric Acid (CAS 7664-38-2)				

Section III - Physical/Chemical Characteristics

Boiling Point	181°F	**Specific Gravity (H_2O = 1)**	1.1 to 1.1
Vapor Pressure (mm Hg)	35	**Melting Point**	N/A
Vapor Density (AIR = 1)	1.27	**Evaporation Rate (Butyl Acetate = 1)**	1

Solubility in Water Complete

Appearance and Odor Light yellow liquid. Pungent, acid odor.

Section IV - Fire and Explosion Hazard Data

Flash Point (Method Used) Not flammable	**Flammable Limits** N/A	**LEL**	**UEL**

Extinguishing Media For fires in the area use water, foam, dry chemical or CO2.

Special Fire Fighting Procedures Neutralize with chemically alkaline substances, such as Soda Ash or Slaked Lime. Cool the containers with water, if exposed to fire wear full protective clothing.

Unusual Fire and Explosion Hazards Contact with common metals may produce a flammable potentially explosive Hydrogen Gas

(Reproduce locally) **OSHA 174, Sept.**

Section V - Reactivity Data

Stability	**Unstable**		**Conditions to Avoid**
	Stable	X	Do not store near or mix with strong alkalies such as Sodium or Potassium Hydroxide.

Incompatibility (Materials to Avoid Corrosive to most metals with evolution of Hydrogen Gas. May react with Cyanides, Sulfides or Formaldehyde releasing toxic gases.

Hazardous Decomposition or Byproducts
Hydrogen Chloride gas and Hydrogen

Hazardous Polymerization	**May Occur**		**Conditions to Avoid**
	Will Not Occur	X	

Section VI - Health Hazard Data

Route(s) of Entry: **Inhalation?** YES/Primary **Skin?** YES/Primary **Ingestion?** YES/Secondary

Health Hazards (Acute and Chronic)
Excessive contact can cause eye and skin burn. Ingestion causes severe burns to mouth, esophagus and stomach. Vapor extremely irritating

Carcinogenicity: **NTP?** **IARC Monographs?** **OSHA Regulated?**
Not listed as carcinogenic by NTP, IARC & OSHA

Signs and Symptoms of Exposure
Irritation of eyes and skin. Inhalation of fumes may result in coughing and choking sensation.

Medical Conditions
Generally Aggravated by Exposure

Emergency and First Aid Procedures See the attached sheet.

Section VII - Precautions for Safe Handling and Use

Steps to Be Taken in Case Material is Released or Spilled Evacuate area; keep upwind until gas has dispersed. If necessary to enter spill area, wear self-contained breathing apparatus & protective clothing including boots. Dike large spills, dilute and neutralize washing with Lime or Soda Ash. Comply with Federal, State and local regulations.

Waste Disposal Method Flush thoroughly with water applied to entire spill. For large spill washing should be neutralized with Soda Ash or Lime before discharging to sewer.

Precautions to Be Taken in Handling and Storing Keep container tightly closed. Keep away from heat, sparks and flame. Keep in cool place. Do not mix Cyanides, Sulfides or Formaldehyde. Keep the container from damage.

Other Precautions
Store container out of sun and away from heat. Never use pressure to empty containers.

Section VII - Control Measures

Respiratory Protection (Specify Type) Self contained breathing apparatus or mask with canister for HCL fumes.

Ventilation	**Local Exhaust** Maintain adequate ventilation	**Special** N/A
	Mechanical (General)	**Other**

Protective Gloves Long rubber or plastic gloves	**Eye Protection** Chemical safety goggles and face shield.

Other Protective Clothing or Equipment
Rubber apron, rubber boots, long sleeve shirts.

Work/Hygienic Practices
Wash after use. Wash contacted clothing before re-use.

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

MATERIAL SAFETY DATA SHEET

Required under USDL Safety and Health Regulations for Ship Repairing, Shipbuilding and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION 1	
MANUFACTURER'S NAME Mineral Pigments Corporation	**EMERGENCY TELEPHONE NO.** 301-776-2400
ADDRESS (Number, Street, City, and ZIP Code) 7011 Muirkirk Road, Beltsville Maryland 20705	
CHEMICAL NAME AND SYNONYMS Synthetic Ferric Oxide	**TRADE NAMES AND SYNONYMS** Red Iron Oxide
CHEMICAL FAMILY Inorganic Oxide	**FORMULA** Fe_2O_3

CAS# 1309-37-1 — **SECTION II - HAZARDOUS INGREDIENTS**

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS None					

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
None		

SECTION III - PHYSICAL DATA			
BOILING POINT (°F)	N/A	**SPECIFIC GRAVITY (H2O=1)**	5.0-5.1
VAPOR PRESSURE (mmHg)	N/A	**PERCENT VOLATILE BY VOLUME**	N/A
VAPOR DENSITY (AIR=1)	N/A	**EVAPORATION RATE (_____ = 1)**	
SOLUBILITY IN WATER	Insoluble		
APPEARANCE AND ODOR	Red Powder/Odorless		

SECTION IV - FIRE AND EXPLOSION HAZARD DATA			
FLASH POINT (Method Used) N/A	**FLAMMABLE LIMITS**	**LEL** N/A	**UEL** N/A
EXTINGUISHING MEDIA N/A			
SPECIAL FIRE FIGHTING PROCEDURES None			
UNUSUAL FIRE AND EXPLOSION HAZARDS None			

SECTION V - HEALTH HAZARD DATA
THRESHOLD LIMIT VALUE Non-Toxic - 10mg/m^3 - Iron Oxide Funds (ACGIH Lists)
EFFECTS OF OVEREXPOSURE None
EMERGENCY AND FIRST AID PROCEDURES Skin contact - wash with soap & water
Eye contact - flush with large amounts of water

SECTION VI - REACTIVITY DATA			
STABILITY	**UNSTABLE**		**CONDITIONS TO AVOID**
	STABLE	X	
INCOMPATIBILITY (Materials to avoid) None			
HAZARDOUS DECOMPOSITION PRODUCTS None			
HAZARDOUS POLYMERIZATION	**MAY OCCUR**		**CONDITIONS TO AVOID**
	WILL NOT OCCUR	X	

SECTION VII - SPILL OR LEAK PROCEDURES
STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
Handle as normal solid waste
WASTE DISPOSAL METHOD Waste material can be buried in an approved land fill or handled as
inert waste in accordance with Federal, State & Local enviromental control regulations

SECTION VIII - SPECIAL PROTECTION INFORMATION		
RESPIRATORY PROTECTION (Specify Type) Dust masks should be worn		
VENTILATION	**LOCAL EXHAUST** Yes	**SPECIAL**
	MECHANICAL (General)	**OTHER**
PROTECTIVE GLOVES None required	**EYE PROTECTION** Safety glasses recommended	
OTHER PROTECTIVE EQUIPMENT Not necessary		

SECTION IX - SPECIAL PRECAUTIONS
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING
Store dry at ambient temperature
OTHER PRECAUTIONS

MATERIAL SAFETY DATA SHEET

SECTION I

Manufacturers Name — **Emergency Telephone**
American Chemet Corporation 406-227-5302
Attn: W.H. Porter, Jr. or D.B. Brimhall

Address (Number, Street, City, State, Zip)
P.O. Drawer D East Helena, MT 59635

Chemical Name — **Trade Name**
Zinc Oxide — ZINOX

Chemical Family — **Formula**
Zinc Oxide — ZnO

SECTION II-HAZARDOUS INGREDIENTS

	%	PEL	TLV
Zinc Oxide	97.2		
Respirable dust		5mg/m3	5mg/m3
Total dust		15mg/m3	10mg/m3

There is no ACGIH TLV or OSHA PEL for zinc oxide. Exposure is governed by the 8 hour TWA established for inert or nuisance dust.

Zinc oxide is not carcinogenic material as listed by OSHA (29CFR1910) or ACGIH (Appendix A, Threshold Limit Values for Chemical Substances, 1984-85)

SECTION III-PHYSICAL DATA

Boiling Point (F): NA
Specific Gravity: H2O=1 5.6
Vapor Pressure: (mm Hg) NA
Percent Volatile by Volume (1%) 0%
Vapor Density: NA
Evaporation Rate: NA
Solubility in Water: Less than 1%
Appearance and Odor: Fine powder. Buff yellow. No odor.

SECTION III-PHYSICAL DATA

Flash Point	Flammable Limits	Lel	Uel
NA		NA	NA

Extinguishing Media: NA

Special Fire Fighting Procedures: None Known

Unusual Fire and Explosion Hazards: None Known

Date: September 1, 1985

SECTION V-HEALTH HAZARD DATA

Threshold Limit Value: See Section II
Effects of Overexposure: Nausea, chills, diarrhea.
Primary Route of Entry: Inhalation and/or ingestion.
Emergency First Aid Procedure:
Remove to fresh air. Lay patient down. Cover with blanket. If irritated, flush eyes and skin with large volumes of fresh water for 15 minutes. Refer to MD.

SECTION VI-REACTIVITY DATA

Stable X
Unstable
Conditions to Avoid:

Incompatability (Materials to avoid): None Known
Hazardous Decomposition Products:

Hazardous Polymerization	May Occur	Conditions to Avoid
	Will Not Occur X	

SECTION VII-SPILL OR LEAK PROCEDURES

Steps to be taken in case material is released or spilled:
Clean up with vacuum cleaner or conventional tools. dusting.
Waste Disposal Method: Approved landfill.

SECTION VIII-SPECIAL PROTECTION INFORMATION

Respiratory Protection
Cartridge type filter or approved dust mask. Refer to Respiratory Protection devices approved by Bureau of Mines Circular IC 8436.
Ventilation
To keep below listed TLV in Section II, use general dilution type ventilation

Protective Gloves	Eye Protection
Wear if skin contact is probable and skin is sensitive.	Safety glasses or goggles.

Other Protective Equipment:
Long sleeve shirts if contact is probable and skin is sensitive.

SECTION IX-SPECIAL PRECAUTIONS

Precautions to be taken in handling and storing: None Known.
Other Precautions:
Do not take internally. Wash with soap and water after contact.

NA, as used above, means not applicable.

AMERICAN
chemet
CORPORATION

400 COUNTY LINE ROAD
P.O. BOX 437
DEERFIELD, ILLINOIS 60015
Phone (312) 948-0800
Telex 72-4301

JULY 23, 1985

ZINOX

TYPICAL CHEMICAL ANALYSIS

	ZINOX 50	ZINOX 350
TOTAL ZINC (76% MINIMUM)	74.3 %	77.0 %
ZnO	91.7	95.0
SULFUR	1.0	1.0
SODIUM	.1	.1
MOISTURE	3.5	.1
	PPM	
LEAD	.0600	.0600
CADMIUM	.0500	.0500
IRON	.0075	.0075
ARSENIC	<.0001	<.0001
MANGANESE	.0001	.0001
COPPER	.0005	.0005

SURFACE AREA:	25 SQ. M/G	17 SQ. M/G
DENSITY:	35 POUNDS PER CUBIC FOOT	
PARTICLE SIZE:	97% MINUS 325 MESH	
COLOR:	YELLOW-PALE YELLOW	
PARTICLE SHAPE:	NODULAR - PORUS	
TYPE:	PRECIPITATED	
SPECIFIC GRAVITY:	5.6	

SHIPMENTS AVAILABLE IN 50 POUND BAG OR 125 POUND BULK BAGS.

SECTION II: ROUGH TERRAIN FORKLIFT OPERATION

Page	13	Terms and Definitions
Pages	14 - 15	Rough Terrain Forklift Operation

Trainee Section Objectives

A. Define the following terms:

Forklift	Center of Gravity
Maintenance Check	Rear End Swing
Hydraulic Control Levers	Lift Capacity
Lift Lever	Manufacturers I.D. Plate
Tilt Lever	Feathering
Traverse Lever	Extend Lever

B. Describe the mason tenders duties and responsibilities as a forklift operator.

D. Describe the first steps to be taken when starting and operating a forklift.

E. Identify whose recommendations should be followed when maintaining or operating a forklift

F. Identify different types of forklifts.

G. Describe safety precautions to be taken when operating a forklift.

H. Describe proper procedures taken when parking or shutting down for the day.

I. Achieve a minimum 80% score on the MCAA written test and demonstrate competency at forklift operation during the hands-on exercises.

Terms and Definitions

Forklift	A machine designed to lift and transport heavy loads.
Maintenance Check	A procedure performed on motorized machinery to insure the smooth operation of such. Example, checking fluid levels, lubrication, checking for worn or frayed belts, tire inflation, etc.
Hydraulic Control Levers	A variety of levers designed to lift, tilt, extend and traverse a load on the carriage of the forklift.
Lift Lever	A hydraulic control lever designed to raise or lower the forks when picking up or setting down a specific load.
Traverse Lever	A hydraulic control lever designed to move the fork carriage in a side to side motion.
Extend Lever	A hydraulic control lever designed to extend or retract loads away from and back to the forklift.
Center of Gravity	The point on the forklift where the weight is evenly distributed or balanced.
Rear End Swing	A motion that causes the rear end to swing wider than the front when turning. Applies specifically to a forklift designed with rear wheel steering.
Lift Capacity	Lift weight capacity of a given forklift design.
Manufacturer ID Plate	A load chart identification plate located on the body of the forklift to determine the rated lifting capacities of that particular machine.
Feathering	A hydraulic control technique used to lift and land loads smoothly. Feathering the control levers means the opposite of jerking the control levers form neutral to full power positions.

Rough-Terrain Forklift Operation

About a Forklift

Only a trained and authorized individual should operate a forklift. The responsibilities and duties of this individual include performing maintenance checks on the machine at the start and end of the work shift.

During the shift a maintenance check should be performed if the operator notices anything that is not functioning normally or "just doesn't feel or sound right". Don't wait until the end of the shift to check the machine out if you notice a new noise or the controls are not operating the way they normally do. Often small problems can be detected and fixed before they get to be major problems or before they impair the operating efficiency of the forklift and somebody gets hurt.

The manufacturers recommended lifting and transporting capacities are usually posted in the cab or by the operators seat. The operator should be trained in how to read these capacity charts and be constantly aware of the design lifting capacity of the forklift

Never exceed the manufacturers recommended lifting and transporting limits.

Only the manufacturers recommendations should be followed during maintenance and operation

Operating a Forklift

After starting the forklift for the first time during a shift it should be allowed to warm up to normal operating temperature.

Check to insure that the steering, brakes, and back-up alarm systems are operating properly.

Check the gauges to make sure all of the gauges are functioning.

Check hydraulic control levers by operating each lever through a full cycle of movement.

Types of Forklifts

There are 4 basic types of forklifts used in masonry construction. These are the straight mast type; the extended reach-boom type; the extended reach-arm and mast type; and the convertible crane type. Each of these forklifts will have different operating control levers for the different functions. Usually an operators guide to the control levers is posted by the operators seat. If there is not, slowly work each control lever until you identify what function each control lever performs.

Lifting and Transporting Loads

The first rule for lifting and transporting a load with a forklift is to never exceed the manufacturers recommended load limits.

When lifting a load be sure that the forks are fully inserted into the load to be lifted. After the forks begin to lift, tilt the load slightly to rest the load against the fork carriage. Only lift a load when the fork lift is on stable ground and is close to level. Lifting a load too high or on sloped ground can cause the forklift to tip over.

When transporting a load, be aware of the changing ground and project conditions. Be extra careful whenever carrying loads across wet or sloped areas. Watch for overhead obstructions and be certain of the amount of clearance between the boom or mast whenever driving under wires, doorways, and any other overhead obstruction.

Never turn the wheels when the load is elevated. Never carry passengers and never operate the control levers from any other position than the operators seat.

When operating a forklift, always wear a seat belt.

Parking and Stopping the Forklift

When parking the forklift always park on level ground out of mud, deep water, or in the way of the project. Always lower the forks to the ground and set them parallel to

the ground surface. Set the parking brake and neutralize all controls. Before turning off the forklift allow it to idle for a minute or two before turning off the key, this will allow the engine to cool slightly.

Turn off the machine and remove the key. At the end of the shift, perform the shut-down maintenance check.

SECTION III: Masonry Saw Operation

Page 17 Terms and Definitions

Page 18 Masonry Saw

Page 19 All-Purpose Saw

Trainee Section Objectives

A. Define the following terms:

Masonry Saw	Pump
Table Saw	Table
Diamond Blade	Gas Powered Saw
Dry Blade	Set-up
Tear-down	Carborundum Blade

B. Describe the difference between a stationary and a table masonry saw.

C. Describe the duties of the mason tender in relation with the masonry saw.

D. Describe the different types of blades used with masonry saw.

E. Competently set-up, operate, and maintain a masonry saw.

Terms and Definitions

Culls	The unusable pieces from cut block or brick
Carborundum Blade	A circular disc made of the abrasive material carborundum.
Diamond Blade	A circular metal disc with diamond cutting edges laser welded to it.
Dry Blade	A diamond blade that has been designed to be used without water. A carborundum blade is also known as a dry blade.
Gas Powered Saw	A 2-cycle powered masonry saw.
Pump	An electrically powered water pump that is part of the masonry saw accessories.
Quickie Saw	A trade name for an all-purpose portable saw. Usually powered by a 2-cycle gas engine.
Masonry Saw	An electrical or gas powered implement that will cut or score block or brick.
Set-up	The process of getting the saw ready for use, such as; mounting the blade, checking the water pump, and plugging in the electrical power.
Table Saw	A masonry that is portable and may be used right on the scaffold when making cuts.
Tear-down	Taking all of the attachments off the masonry saw, cleaning the tray and storing all accessories.
Table	A platform on rollers that sits on the masonry saw tray. Used to place block or brick on when cutting.

Masonry Saw Operation

About the Masonry Saw

The masonry saw is a tool used to cut and score block and brick. The mason tenders duties are to set-up the saw with the necessary accessories and ready it for the masons use. Most masonry saws are set up to use water coolant and a diamond blade. The water can be supplied to the blade by a hose or the saw may be equipped with a pump that draws from the water tray and sprinkles water back on the blade. It is extremely important that the water supply system is working properly when cutting with a blade that requires water.

Masonry saws can also be equipped with diamond or carborundum blades that are designed to cut without using water as a coolant. This is refered to as a "dry blade".

Masonry saws can be portable or stationary, the difference is a stationary saw is usually attached to skids or a pallet-like structure and requires a forklift to transport it.

Masonry saws can be powered by gas or electricity. Gas engines can be 2-cycle or 4-cycle and it is the mason tenders responsibility to insure that the engine is fueled with the correct fuel. (ie. oil/gas mix for 2-cycle and gas only for 4-cycle engines.) For 4-cycle engines check the oil level frequently to prevent a low oil situation from burning up the motor.

If the motor requires electricity, make sure you are connected to the correct voltage. Masonry saws are available that require 110-volt circuits and 220-volt circuits. It is your responsibility to be aware of which voltage your saw requires and that you connect it to the proper line voltage.

Set-up and Maintenance

The set-up for a masonry saw can be started by mounting the blade. The mason tender should know how to mount a blade on the saw. To mount a blade first, remove the bolt and the outside mounting washer from the shaft. Check the rotation direction arrow on the blade and mount the blade on the shaft. Put on the outside mounting washer and bolt. Tighten the bolt until the blade is securely fastened to the shaft.

If the saw is equipped with a water pump mechanism, fill the tray and check during the shift to insure that the water level remains adequate to maintain a coolant stream on the blade.

It is good practice to keep a drum of water close to the saw so the tray can be filled easily when needed. Also keep a trash barrel close to the saw for culls.

During the shift it will be necessary to drain the water tray and remove the sludge from cutting. If the sludge is allowed to build up it may plug the intake fitting or filter on the water supply system. Dispose of the water away from the saw so you don't create mud and slipping hazards around the saw.

Tear-down

At the end of the shift it is the mason tenders responsibility to drain, clean and store the saw. Take all of the accessories off the saw and wash with water before storing. Disconnect all cords and roll them up for storage. Disconnect the water pump, clean it and blow through the supply hoses to make sure there is no water or blockages remaining in the hose. It is critical to completely drain the hoses and pump if you are working in an area that is likely to freeze.

The Portable All-Purpose Saw

The portable all-purpose saw is usually powered by a 2-cycle gas engine. 2-cycle engines require an oil/gas fuel mixture and the manufacturers recommended mix ratio should be followed accurately when mixing.

This saw can use a variety of blades to cut different materials. It can be mounted with an abrasive blade such as a Carborundrum blade for cutting concrete, masonry, ductile iron and steel. It can also be mounted with a diamond blade for cutting concrete and masonry but will usually need to be fitted with a water attachment to cool the blade. Be sure to check the label on the blade to make sure it is the correct blade for the material you are going to cut. The label on the blade will also describe the maximum rotation speed for the blade. Make sure that the blade is rated correctly for the saw you are going to mount it on.

When mounting a diamond blade, be sure that you mount the blade with the rotation arrow pointing in the same direction that the shaft will rotate. Also check to see if the blade requires water or not.

All-Purpose Saw Maintenance

The major maintenance concern for maintaining the all-purpose saw is the fuel. Mixed fuel must be used in a 2-cycle engine. Be sure to check the saw manufacturers recommendation about the gas/oil mix ratio.

The air filters are usually constructed in a 2 filter manner. Both filters must be kept clean and free of debris.

Cutting blades for free-hand cutting operation are subjected to particularly high bending and compressive stresses. Top quality blades which match the engine speed must be used. Out-of-round or poorly balanced blades will increase vibration and reduce the service life of the saw. Abrasive blades are heat sensitive and should be stored in a dry place at a relatively constant temperature.

All-Purpose Saw Operation

When starting the all-purpose saw, place the saw on the ground, be sure nobody is in the working area of the saw and the blade is free to rotate. A cold engine is started with the choke in the fully closed position regardless of the time of year. A warm engine is started with the choke in the fully open position.

Move the start switch to the "on" position and set the throttle trigger to the half throttle position. Hold the handle bar with one hand and pull the starter grip with the other hand until a definite resistance is felt, give the rope a strong, sharp pull. Do not allow the starter rope to fly back into the retriever. Keep the choke closed only until the engine fires then quickly turn the choke to the open position. If the engine stops, repeat the procedure. If the choke is left closed after the engine fires the engine will flood. When the engine is started "warm it up" by "revving" the engine several times. Stop the engine by moving the switch to the off position.

Before making a cut, always adjust the blade guard so the operator is not endangered by particles from the cut and make sure you are wearing safety goggles or glasses.

Always use full throttle during a cut. This will keep the blade rotating at the designed speed. Let the saw make the cut, do not force the blade into the work. To achieve a clean and efficient cut, pull the blade across the work or move it to and fro in the cutting direction. Keep the saw in-line with the cut to avoid binding the blade against the cut walls.

After the cut is complete the engine should be turned off. Never carry the saw from one cut to another with the engine running and carry the saw with the blade facing the rear.

When sawing concrete with abrasive blades a large amount of dust will come from the cut. Wear a respirator and try to keep the dust from entering the air intake on the saw. Clogged air filters reduce engine power, increase fuel consumption and make starting more difficult. Clean or change the air filters if they become clogged.

Section IV: Mortar, Grout, and Additives

Pages 21 - 22	Mortar and Efflorescence
Pages 23 -24	Mortar Admixtures
Page 25	Colored Mortar
Page 26	State-of-the-Art Mortar Mixing Techniques
Page 27	Grout
Pages 28 - 31	Estimating Mortar and Grout Quantities
Pages 32 - 34	Cleaning New Masonry

Trainee Section Objectives

A. To identify different mortar mixes and the uses of each type.

B. To identify the need for; and uses of; different admixtures in mortar.

C. To identify and correct problems in mortar mixes.

D. To become aware of the materials used in; and the mixing of the pigments for colored mortar.

E. To become aware of new developments that affect mortar mixing.

F. To become competent in estimating mortar and grout quantities.

G. To describe the use of grout in different reinforced masonry construction.

H. To become competent in the use of different masonry cleaning techniques.

Mortar

Masonry mortar has four functions:

1. To bind the block or brick units together in a stable structure.
2. Provide an effective barrier to the infiltration, absorption, or passage of moisture into or through the wall.
3. To be weather resistant.
4. To provide a neat and uniform appearance.

Portland cement mortars can be made using two different types of portland cement. Type I portland cement is general purpose and is most common. Type III is a high early strength cement and is used when fast setting is needed in cold weather. When using portland cement for mortar, hydrated lime must be added to keep the mixture from becoming stiff, sticky and hard to use by holding water in the mix.

Most mortar used today is made of masonry cement. Masonry cement is factory mixed and composed of portland cement, lime and some admixtures. Being factory mixed masonry cement mortar provides a more uniform appearance, fewer materials are needed at the jobsite and there are fewer chances of error when proportioning the mix.

Mortar mixes used today must conform to ASTM specification C270 "Mortar for Unit Masonry". Mortar is classified by the letter types M, S, N, O, and K. These letters were chosen by dropping every other letter in MaSoNwOrK.

Type M is a high strength mix that offers greater durability than other mortar types. It is used for reinforced or unreinforced masonry that is subjected to high compressive loads, severe frost action, violent winds and seismic loads. Type M may be used in high rise buildings, structures below grade and in contact with the soil such as foundations, retaining walls, walks, sewers and manholes.

Type S is a medium strength mortar that achieves high tensile bond strength. Use type S mortar for structures subject to normal compressive loads, but require high flexural bond strength. Type S can also be used below grade, in contact with the soil, and as a bonding agent between facing and backing, such as adhesion type terra-cotta veneers.

Type N is a general purpose mortar used in nonload bearing and above grade interior and exterior walls. Type N is used for laying brick, concrete block, stone and glass block. This type mortar provides medium strength, good workability and economy and is usually water-proofed to provide for weather protection.

Type O is a high-lime low-strength mortar used for interior non load-bearing partition walls. Type O mortar walls should not be subjected to freezing temperatures.

Mortar must develop certain properties in order to produce quality masonry work.

Plasticity - the unhardened mortar must be very plastic, smooth and workable to spread with a minimum of effort to cover the surfaces to be coated and bonded.

Body - mortar must possess sufficient body and cohesiveness, it must be able to adhere to itself and to all masonry surfaces. The mortar must resist being squeezed off of the joints and prevent uneven settlement as additional courses are being added.

Water retention - to resist the loss of water to absorbent masonry units and to resist bleeding when used with non-absorbent units. Loss of water will reduce plasticity, bond between the masonry units and strength development.

Bond - the most important factor in masonry construction is the bond which holds masonry units together. To make a thorough bond, coat all contact surfaces fully and evenly with mortar.

Strength - an important strength in masonry work is resistance to tension and buckling. In most cases in which ruptures occur the masonry unit and mortar joint are undamaged and the failure is due to poor bond.

Water repellency - qualities which provide a good bond between masonry units and mortar also contribute to watertightness and water repellancy.

Efflorescence

Efflorescence is the biggest mortar problem in masonry construction. Efflorescence is deposits of salt on the surface of masonry walls. Efflorescence occurs when the wall contains some soluble salts and when sufficient moisture is present to make the salts bleed. The salts can be in the masonry units or in the mortar itself. When an excessive amount of calcium chloride, and accelerator used to speed setting in cold weather, is used efflorescence may occur. Table 4-1 shows common sources of efflorescence.

Listed below are several ways to prevent efflorescence:

1. Reduce salt content by using washed sand
2. Use clean mixing water in the mortar
3. Keep materials on the job covered and stored off the ground
4. After the wall is built, cover it with a canvas or plastic
5. Quality workmanship and a good bond between the masonry units and mortar
6. Keeping moisture out of the wall at all times will prevent efflorescence.

Removing efflorescence can be accomplished by washing the wall with a diluted solution of 1 part muriatic acid to 10 parts water.

Table 4-1: Common Sources of Efflorescence

Principal Effloresc ing Salt		Most Probable Source
Calcium sulfate	$CaSO_4 \cdot 2H_20$	Brick
Sodium sulfate	$Na_2SO_4 \cdot 1OH_4O$	Cement brick reactions
Potassium sulfate	K_2SO_4	Cement brick reactions
Calcium carbonate	$CaCO_3$	Mortar or concrete backing
Sodium carbonate	Na_2CO_3	Mortar
Potassium carbonate	K_2CO_3	Mortar
Potassium chloride	KCI	Acid cleaning
Sodium chloride	NaCI	Sea water
Vanadyl sulfate	$VOSO_4$	Brick
Vanadyl chloride	$VOCI_2$	Acid cleaning
Manganese oxide	Mn_3O_4	Brick
Iron Oxide	Fe_2O_3 or $Fe(OH)_3$	Iron in contact or brick with black core
Calcium hydroxide	$Ca(OH)_2$	Cement

Mortar Admixtures

Mortar admixtures are materials added to a mortar mix in small amounts to achieve a particular result. Precautions must be taken when using admixtures. Always follow manufactures recommendations on the amount of admixture to be used. Make sure mortar made with admixtures will meet ASTM C270 specifications. Be sure the admixture will not harm other important properties of the mortar such as bond or cause corrosion of reinforcing steel. Do not use admixtures unless they are specified or when necessary such as during cold weather when an accelerator may be used.

Air-Entraining Agents

Air-entraining agents are used in masonry mortar to increase resistance to freezing and thawing cycles. This admixture traps microscopic bubbles in the mix which allows the mortar to expand and contract during freeze-thaw cycles reducing the likelihood of cracks. In fresh mortar these bubbles act as a lubricant which helps increase workability because of water retention. Masonry cement or portland cement-lime should be used that have air-entraining agents already in them, because air content is difficult to control when added in the field. Mortar that contains more than 12% air by volume will weaken the bond strength of the mix. Air-entrainment ingredients include: neutralized vinsol resins (most common), organic acid salts, fatty acids and hydrocarbon derivatives.

Accelerators

Accelerators speed up cement hydration, shortens setting time by 30% to 48% and increases 24-hour strength by 150% or more. Accelerators are used in cold weather construction to speed up the setting time of mortar. Water-reducing accelerators increase early strength and ultimate strength by reducing the water-cement ratio of the mix. Accelerators are added to the mixing water. Calcium chloride should not exceed 2% by weight of portland cement or 1% by weight of masonry cement. For non-chloride accelerators use not more than 3% to 5% by weight of portland cement or 1.5% to 2.5% by weight of masonry cement.

Follow other cold weather construction practices such as keeping masonry units dry, heating materials, building wind breaks around mixers and scaffolds and covering the newly laid walls with insulated blankets for 24 hours.

Calcium chloride may cause efflorescence and can lead to corrosion of steel ties and reinforcement and should not be used in mortar that will come in contact with metals. Accelerators will not prevent mortar from freezing.

Accelerator products include: calcium chloride, calcium nitrate, and other aqueous solutions of organic and inorganic polymeric compounds.

Retarders and Extended-Life Retarders

Retarders are used to slow the fast setting of mortar in hot weather caused by high evaporation rates of the mix water. They also prevent hot, dry brick and block from absorbing the mix water to achieve a better bond. Retarders extend the board life of fresh mortar for as long as 4 to 5 hours, and helps the mix retains its moisture which will eliminate the need to re-temper. Mortar with retarder added will trowel easier, have less shrinkage and increased strength.

Retarders can be added to the water or directly to the mix at a rate of 0.5% to 1% by weight of cement. Do not add more than manufacturer recommends because mortar will not set. Do not re-temper mortar with retarder added.

Ingredients used for retarders include sodium gluconate, sodium lignosulfunate, or sodium citrate.

Extended life retarders are used in ready mixed mortars or on-site mobile batcher-mixers. They slow the reaction time of cement and water to give the mortar a 12

to 48 hour life depending on the dosage. These retarders have little effect on setting time because they are absorbed by the masonry units allowing the normal cement hydration to take place. High temperatures may require increased amounts of extended-life retarders.

Most extended-life retarders increase air-entrainment slightly, so when used with air-entrainment agents care must be taken to limit the air content to 12%.

Bond Modifiers

Bond modifiers improve adhesion and surface density or mortar to improve bond to smooth dense-surfaced units, such as glass blocks and glazed brick. This admixture is added to the mixer before other ingredients. Some are added in ratios of 1 gallon per sack of cement. Bond modifiers should not be used with air-entraining agents or air-entraining cements. Ingredients include acrylic polymer latex, polyvinyl acetate, styrene butadiene rubber and methol cellulose.

Corrosion Inhibitors

Corrosion inhibitors helps offset the effects of chlorides in mortar and prevents steel from corroding. This additive should be used only in mortar or grout with embedded steel. Corrosion inhibitors should be used in marine environments or where de-icing salts are used.

Corrosion inhibitors may speed up setting time of mortar and reduce air-entrainment.

Water Repellents

Water repellents help reduce water absorption of the hardened mortar by as much as 60% without affecting design strength. Water repellents must be added to both the masonry units and mortar to be effective. Be sure this additive is compatible with other admixtures used in the mortar. If added only to the mortar water repellents may decrease bond strength and retard set. Because integral water repellents reduce vapor transmission through mortar joints the cavity should be vented so vapor is not trapped in the wall.

Proprietary Plasticizers

When a mortar mix is workable it has a smooth, plastic consistency, it sticks well to vertical surfaces and spreads easily with a trowel. Placticizers give mortar its workability and buttery effect. Lime is the oldest plasticizer and has been used for thousands of years, but sets up too slowly for today's fast paced construction. Lime also improves bond and increases water retention, but mortar made with lime has a shorter board life than mortars made with plasticizers and lime can burn a persons skin.

One plasticizer which completely replaces lime uses natural bentonite clay as a lubricant. The clay helps retain moisture and give mortar 2 to 4 times the board life than that of lime. Because the clay absorbs so much water, 7 lbs. of this plasticizer can replace a 50 lb. bag of lime and more sand can be used per bag of mortar. Other plasticizers include a liquid resin-based chemical concentrate and other clear thick liquids. These plasticizers can be used to completely or partially replace lime in the mortar mix. Proprietary plasticizers reduce efflorescence, cause less shrinkage, increase compressive and bond strengths and allow more sand per bag of mortar to be used. These plasticizers cause mortar to set more slowly in cool weather and are recommended for use in hot weather construction.

Note: Proprietary means the plasticizer is covered by a trademark, patent, or copyright by a private person or company.

Colored Mortar

To use colored mortar successfully everything must be consistent including the ingredients, the proportions, job conditions and workmanship. Color can vary because of inconsistent joint tooling. The most favorable materials for coloring mortar are iron oxide pigments. They are nontoxic, color fast and chemically stable in mortar. Natural iron oxides are manufactured by grinding iron ore into fine particles. Synthetic iron oxides are manufactured in several ways, by precipitation of iron salts, and as a byproduct in the manufacture of aniline, which is used in dyes. Table 4-2 shows the pigments used for different colors in mortar.

Table 4-2: Materials Used for Colors in Mortar

Color		Pigment
Red/Pink	-	Natural red iron oxide
Bright Red	-	Synthetic red iron oxide
Chocolate	-	Natural red & yellow & carbon black
Black	-	Synthetic & carbon black
Buff	-	Natural yellow & red
Green	-	Chromium oxide
Blue	-	Cobalt

Colored mortars can be made two ways: by using powdered or liquid pigments mixed into the mortar at the job-site or by purchasing pre-colored, pre-bagged masonry cements. Most of the colored mortar used today (about 70%) is made from powdered pigments. Those pigments are packaged so 1 bag of colored pigment is used for each bag of masonry cement, portland cement and lime used in the mix. See Table 4-3.

Type N mortar is easier to color than type M and type S because it contains less cement and lime as these materials are harder to color. When mixing colored mortar never add the color pigments (powder or liquid) last. Add 1/2 of the water and 1/2 of the sand to the mix, then add the color pigments and let mix for 1 minute. Next, add the cement and lime or masonry cement and the balance of water and sand. The sand must be kept at the same moisture content when mixing colored mortar because volume changes between wet and dry sand can cause color variations. Color can also be affected by re-tempering mortar and temperature extremes.

Table 4-3: Mix Proportions For Colored Mortar

Mortar Type	Portland Cement 94# bags	Masonry Cement 70-80# bags	Hydrated Lime 50# bags	Sand damp, loose cubic feet	Packages of Powder Pigment
M	--	1	--	3	1
M	1	1	--	6	2
M	2	--	1/2	6	3
S	--	1	--	3	1
S	1	2	--	9	3
S	2	--	1	9	3
N	--	1	--	3	1
N	1	--	1	6	2
O	--	1	1	6	2
O	1	--	2	9	3

Note: These are proportions recommended by one pigment manufacturer for use with its powder pigments. Most other manufacturers provide similar charts. Pigment usually is packaged so one bag contains enough pigment to color one bag of cementitious material (portland cement, masonry cement, or lime).

Tooling of joints must be done when the mortar reaches the same consistency throughout the job. Mortar should be thumb print hard when tooled, too soft will lighten the color and too hard will darken the color. Cleaning brick before mortar hardens on them is essential. Scrub mortar droppings off the brick with water and a stiff brush to avoid using acid cleaners which can wash away the color. As mentioned earlier, the key to good colored mortar is consistency. Mix each batch exactly the same using the same ingredients at the same amounts. Use the same brand of cement and lime and get sand from the same source. Add the same amount of water and mix each batch the same amount of time.

State-of-the-Art Mortar Mixing

Mortar Silo System

Mortar silos have been designed with one or several material compartments. Silos with one compartment mix in pre-blended mortar ingredients while multi-compartment silos store mortar ingredients separately and mix them on site in the mixing auger. In two compartment silos the sand compartment is three times larger than the cement compartment. Augers meter the cement and sand into the mixing auger. Water is added in the 5 foot mixing auger and mortar is dispensed into wheelbarrows or mortar tubs at a rate of 4 cubic yards per hour. To change the sand-cement ratio adjustments are made to the metering screws which feed the materials into the mixing auger. Figure 5-1 shows a two compartment silo system. The 14 cubic yard silo can provide mortar for about a week on most jobs. Silos are delivered to the job site on trucks and when empty are returned to the plant for refilling.

One compartment silos are filled with pre-blended materials. The sand is dried before use to prevent freezing, a more consistent mix and lower shipping costs. One compartment silos can hold up to 24 cubic yards of dry materials and because of bridge load limits are delivered to the job site half full. When empty, the silos are refilled using a 30-ton bulk tank which fills the silo using a pneumatic bulk-dispensing conveyor. 30 tons of materials usually last for 2 to 3 weeks.

Mobile Batcher-Mixer Trucks

Mobile batcher-mixer trucks have material bins and tanks that contain sand, cement, lime, water, chemical admixtures, and coloring agents. These trucks can batch and mix any desired or specified mortar type and can service several job sites at once.

Continuous Mixers

Continuous mixers use a mixing auger similar to the mortar silos and mobile batcher-mixers. A hopper is filled with a pre-blended dry mortar and water is automatically injected into the mixing chamber. The water ratio is set to provide the desired slump. The mixed mortar is automatically dumped into a wheelbarrow or mortar box.

Mortar silos, mobile batcher-mixers, and continuous mixers all provide the contractor with a means of providing a consistent quality mortar. There is no waste when using these auger type mixers, no sand piles to clean up or thaw out and less time is required for clean-up.

Grout

Grout for masonry is a mixture of cement, aggregate, and enough water to cause the mix to flow into the hollow masonry without segregation. The size of the aggregate in grout is dependent on the size of the openings or grout spaces and the height of the grout lift. For low lift fine grout, (sand and cement) openings should not be less than 3/4" wide in collar walls or 2" x 3" in hollow masonry units. In high lift grouting where the smallest horizontal opening is three inches, course grout (cement, sand, and peagravel) can be used.

Grout specifications should comply with ASTM476 Standard Specifications for Mortar and Grout for Reinforced Masonry. Table 5-4 shows grout proportions for fine and course grout.

Most masonry grout contains fly ask as a partial replacement of the portland cement. Fly ash increases strength and acts as a water-reducer. Admixtures are used in grout only when specified by the engineer as required by ASTM C476. Non-corrosive accelerators are used during cold weather and retarders are used to control the set during hot weather. Plasticizers are used to increase slump without adding water and maintain water-cement ratios and high strength.

Shrinkage-compensating admixtures are the most common used in grouting. These admixtures expand the grout, retard the set and act as a water reducer. These reactions reduce shrinkage from water loss to the masonry units and allow more time for consolidation before the grout sets up.

Grout should be batched, mixed, and delivered to the job site and placed in less than 90 minutes. Because of its high slump, grout should be continuously agitated after mixing until placement.

Grout is usually placed in lifts not more than 5 to 6 feet high. Several lifts make a grout placement that should not exceed 24 feet. The height of a grout placement is determined by course or fine grout and the size of the openings or grout space, Course grout and placements in smaller openings must be placed in smaller lifts than fine grout. Clean-outs must be placed at each vertical bar in hollow grouted construction and every 32 inches in multi-wythe construction. These openings provide for inspection and easy removal of debris before grouting. Clean-outs are only necessary when a grout placement exceeds 5 feet.

When grouting, always be aware of reinforcement position and always consolidate the grout at time of placement. Re-consolidate it within 1/2 hour after placement. Because masonry units absorb water from the grout, full height grouting can be accomplished with one lift. Full height grouting eliminates cold joints, provides better bond with the reinforcing, and saves time.

Placing grout on small jobs can be done with pails, shovels, and wheelbarrows. Large masonry job sites utilize grout pumps for placing grouting in high lifts and full height grouting. Grout is discharged from redi-mix trucks in the pump hopper where a twin cylinder pump forces the mix through a pipeline to the wall. Pump capacities range from 20 to 60 cubic yards per hour.

Grout pumps should be able to pump mixes which contain 3/8" MSA to 1" MSA. Pump selection includes maintenance costs, clean up efficiency, operating costs, and accessories. Locate the pump at the job site where it will be readily accessible to ready mix truck and where the shortest amount of hose will be required. Pump lines must be lubricated with a slurry mix of 1/2 bag cement mixed with 5 gallons of water. Try to schedule grouting operations once or twice a day to minimize start up and clean-up of equipment and delivery of grout from the ready mix plants.

Pumping operations should be set up to start grouting with the longest amount of hose and work toward the pump. This set up will allow the clean up of hoses as the grouting operation progresses. When grouting operations are complete excess grout can be pumped back into the ready mix truck to reduce clean up.

Estimating Mortar Quantities

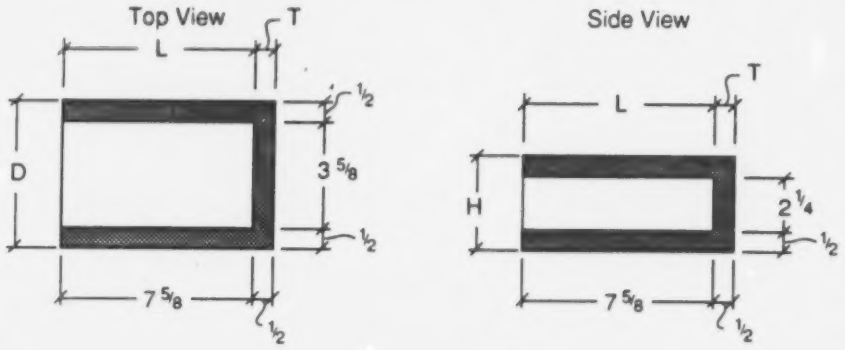
To maintain sufficient amounts of materials for mortar on the job site and to reduce the amount of mortar waste, estimating mortar quantities is necessary. Figure 4-2 shows the dimensions and formulas used to estimate mortar for two common masonry units using standard 3/8" mortar joints. Note that in the calculations, 1/2" is used instead of 3/8" for joint thickness. This allows for waste and tooling. Table 4-4 shows how many cubic yards of mortar is needed to lay 1000 block or brick of different sizes.

Study the examples on pages 30 - 31 and work the exercises.

Table 4-4:
Mortar Requirements for Block and Brick

Block Size	Cubic Yards/1000
Concrete Block with 3/8" Joints	
4x8 x16H	1.019
4x8 x16S	1.178
6x8 x16H	1.146
6x8 x16S	1.687
8x8 x16H	1.146
8x8 x16S	2.196
10x8 x16H	1.273
10x8 x16S	2.705
12x8 x16H	1.273
12x8 x16S	3.214
4x2 1/4 x16S	0.911
4x4 x16H	0.847
4x4 x16S	0.979
8x4 x16H	0.953
8x4 x16S	1.823
12x4 x16H	1.059
12x4 x16S	2.673
Facing Brick with 3/8" Joints	
4x 2 1/4 x 8S	0.515
4x 2 1/4 x 12S	0.713
4x 2 3/4 x12S	0.738
4x 4 x 8S	0.580
4x 4 x 12S	0.781
4x 8 x 8H	0.692
4x 12 x 12H	1.036
6x 2 3/4 x 12S	1.057
6x 4 x 12S	1.119
6x 4 x 12H	0.676
8x 4 x 12H	0.676
8x 4 x 12S	1.456

Modular Face Brick - Solid $^{3}/_{8}$" Joints



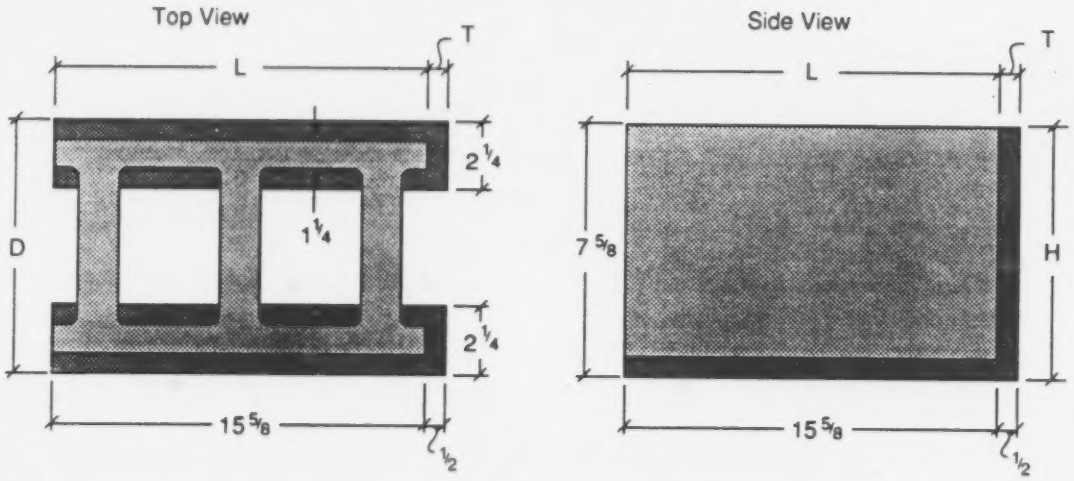
(L + H) X D X T = Cu. In.

(10.375 x 4.625 x .50 = 23.993 Cu. In.

$$\frac{\text{Cu. In.}}{46.656} = \text{CY/M}$$

$$\frac{23.993}{46.656} = .515 \text{ CY/m}$$

8 x 8 x 16 Concrete Block -$^{3}/_{8}$ " Joints



(L + H) x 2D x T = Cu. In.

23.75 x (2 x 2.25) x .50 = 53.436 Cu. In.

$$\frac{\text{Cu. In.}}{46.656} = \text{CY/M}$$

$$\frac{53.436}{46.656} = 1.146 \text{ CY/M}$$

Figure 4-2
Example mortar quantity calculations.

Estimate Mortar Exercise

Example: Estimate mortar for 4,500 modular face brick

Nominal size = 2 1/4" x 4" x 8"
Actual size = 2 1/4" x 3 5/8" x 7 5/8"

Formula from Figure 4-2

= (L+H) x D x T = Cu. In.
= (8 1/8" + 2 1/4) x 4 5/8 x .50
= 10.375 x 4.625 x .50
= 23.993 Cu. In.

Constant from Table 4-4

$= \frac{\text{Cu. In.}}{46.656}$ = Cu. Yd. per thousand Brick

$= \frac{23.993 \text{ cu. in.}}{46.656}$ = .515 Cu. Yd. per thousand Brick

= .515 cu. yd/M x 4.5 = 2.32 cu. yd. for 4,500 brick

Exercise: Calculate the mortar requirements for:

a. 8,000 brick, nominal size 2 1/4" x 4" x 12"
b. 24,000 brick, nominal size 4" x 4" x 8"

Estimate Mortar Exercise

Example: Estimate mortar for 2,380 8" x 8" x 16" block

Formula from Figure 4-2

= (L+H) x 2D x T = Cu. In.
= (15⅝" + 8⅛") x (2 x 2¼" x .50
= 23.75 x 4.5 x .50
= 53.436 Cu. In.

Constant from Table 4-4

$= \frac{\text{Cu. In.}}{46.656}$ = Cu. Yd. per thousand Brick

$= \frac{53.436 \text{ cu. in.}}{46.656}$ = 1.146 Cu. Yd. per thousand Brick

= 1.146 cu. yd./M x 2.38 = 2.73 cu. yd.

Exercise: Calculate the mortar requirements for:

a. 5,200 block, 6 x 8 x 16
b. 12,000 block, 12 x 8 x 16

Estimating Grout Quantities

To estimate grout quantities for reinforced grouted masonry, use the same procedures as for concrete quantities. The basic formula is:

L x H x T÷ 27 = Cubic Yards Required

Where:

L = Length of wall in feet
H = Height of wall in feet
T = Thickness of the collar joint in feet

To estimate grout quantities for filled cell masonry, data from the manufacturer is necessary. Table 4-5 shows the grout requirements for different size block. Information in columns A, B, C, and D is form the block manufacturer and columns 1, 1a, 2, 3, and 4 can be calculated using this data.

Study the example on page 33 and work the exercises.

Table 4-5: Grout Requirements for Different Styles Concrete Block

Width x 8x 16 inches	Cores	Gross volume (CF)	Volume of voids (CF)	Percent solid	Equivalent thickness (inches)	Shell thickness (inches)	Mortar (CY/M)	Fill (CY/M)
4	3	.250	.067	73.5	2.66	1.000	1.02	2.5
6	2	.388	.141	63.6	3.57	1.250	1.15	5.3
8	2	.526	.257	51.2	3.90	1.250	1.15	9.6
8	3	.526	.221	58.0	4.42	1.250	1.15	8.2
10	2	.664	.320	51.8	4.98	1.500	1.28	11.9
12	2	.802	.435	45.8	5.32	1.500	1.28	16.2
12	3	.802	.354	55.9	6.49	1.500	1.28	13.2
8	2	.526	.208	60.5	4.61	1.500	1.28	7.8
8	2	.526	.181	65.7	5.00	1.750	1.40	6.8
8	3	.526	.132	75.0	5.71	2.125	1.60	4.9
12	3	.802	.337	58.0	6.74	1.750	1.40	12.5
6	3	.388	.097	75.0	4.21	1.875	1.47	3.6
12	2	.802	.201	75.0	8.71	3.375	2.23	7.5
4	0	.250	.000	100.0	3.62	-	1.18	-
6	0	.388	.000	100.0	5.62	-	1.69	-
8	0	.526	.000	100.0	7.62	-	2.20	-
12	0	.802	.000	100.0	11.62	-	3.22	-
8	Ivany	.526	.305	42.0	3.20	1.250	1.15	11.3
12	Ivany	.802	.529	34.0	3.95	1.250	1.15	19.6
(A)	(B)	(1)	(1a)	(C)	(2)	(D)	(3)	(4)

Mortar, Grout and Additives

Estimate Grout Exercise

Example: Estimate reinforced grout masonry wall 12' x 94' with 2 3/4" collar joint.

Formula

= L x H x T + 27 = Cu. Yd.
= 94' x 12' x .23' + 27 = 9.61 Cu. Yd.

Exercise: Estimate the grout requirements for the following walls:

a. 11'-4" x 236' with 3 1/2" collar joint
b. 14'-8" x 196' with 2 7/8" collar joint

Example: Estimate the grout requirements for a Filled Cell Masonry Wall using 10" block - 10'-8" x 168'.

Find the number of block:

= 10'-8" high = 16 courses
= 168' long = 126 block long
= 16 x 126 = 2016 block

From Table 4-5 column (4) 11.9 cu. yd. per thousand block

= 11.9 x 2.016 = 23.99 cu. yd. of grout

Exercise: Estimate the grout requirements for the following walls:

a. 8'-8" x 324' with 12" block 2 cores, shell thickness = 1.5"
b. 13'4" x 212' with 8" block 3 cores, shell thickness = 1.25"

Cleaning New Masonry

Architectural appearance of a masonry wall depends on the attention given to the masonry surfaces during construction and cleaning. Many problems and irreparable damage has resulted from improper cleaning procedures

Cleaning failures and problems result from:

- Not thoroughly saturating the brick masonry surface with water before and after using chemical or detergent cleaners. Dry walls absorb the cleaning solution and leave a white scum or develop efflorescence when they dry out after cleaning.
- Using chemical solutions improperly. Too high concentrations or poorly mixed solutions can wash out mortar joints and discolor masonry units, especially light colored shades. Acid burns from high concentrations also increase the development of green and brown stains. Chemical cleaning solutions work best when the temperature is above 50° F.
- Failing to protect windows, doors, and trim. Acid cleaning agents corrode metals and cause pitting of metals and staining of the masonry surface and other trim materials such as limestone.

Methods of Cleaning New Masonry

Methods of cleaning can fall into three categories:

- Bucket and brush hand cleaning
- High pressure water cleaning
- Sandblasting

(Table 5-5 on page 30 is a condensed guide to cleaning procedures)

Bucket and Brush Hand Cleaning

Bucket and brush hand cleaning is the most common method used to clean masonry, but is often misunderstood. This method is simple to use and cleaning materials are readily available. A general procedure for using acids, detergents, or proprietary compounds is as follows:

1. Select the proper cleaning agent.
   a. Muriatic acid should be mixed at a 10% solution in a non-metallic container. Always pour the acid into the water and don't allow tools to come in contact with the acid solution.
   b. When mixing proprietary compounds always follow manufacturer instructions for dilution. These compounds should be tested in an inconspicuous wall area to make sure they are appropriate for the type of masonry to be cleaned.
   c. To remove mud and dirt use soap or detergent solutions. A suggested solution is to use $1/2$ cup trisodium phosphate (Calgon or equal) and $1/2$ cup laundry detergent dissolved in one gallon of water.
2. Cleaning should be scheduled last, after the mortar has set and cured. Mortar will stain the masonry so avoid waiting long periods before cleaning. Cleaning should begin 7 to 10 days after masonry units are laid.
3. Clean the larger particles from the masonry before wetting wall using wood or non-metallic scrapers. Acid solutions cannot remove large particles.
4. Protect windows, doors, and trim from acid solutions.
5. Flush thoroughly from top to bottom to saturate the masonry and prevent it from absorbing the dissolved mortar or cleaning solution.

6. With a long-handled stiff-fiber brush, apply the cleaning solution beginning at the top of the wall and working down. Let the solution remain on the wall for about 5 to 10 minutes or follow manufacturers instructions. Never use metallic tools to remove stubborn particles. Metal marks will rust and stains will result.

7. Clean small areas, about 20 foot square at a time. Try to work in the shade to prevent the sun from drying the solution before it has time to react on the area.

8. After scrubbing and cleaning rinse the wall thoroughly, Flush with large amounts of water before the solutions are allowed to dry. If solutions are not completely washed from the surfaces a white scum may form.

High Pressure Water Cleaning

High pressure water system include a high pressure gun and nozzle equipped with a control switch. Some guns have two hoses, one that carries water and one that carries a cleaning solution. Nozzle pressures range form 400 psi to 700 psi and apply 3 to 8 gallons per minute.

Cleaning solutions used should be compatible with the equipment and the equipment should be as portable as possible.

High pressure water cleaning should proceed as follows:

1. Choose a small inconspicuous area to test clean. If using an acid solution, be sure it doesn't erode the mortar joints.

2. Follow steps 3, 4, and 5 from bucket and brush cleaning.

3. Spray on cleaning solution with a low pressure hand sprayer at 30 to 50 psi.

4. Allow solution to remain on the wall for about 5 minutes.

5. Rinse completely with large amounts of water to remove the solution. To prevent the solution from being driven into the masonry by the high pressure water, saturate the wall before applying the solution.

Sandblasting

Cleaning of masonry by sandblasting is a method that has been used for many years. It is one method of eliminating mortar smears, acid burns and the efflorescence associated with cleaning solutions. Care must be taken to prevent damage to the masonry face or the mortar joints. Equipment used includes an air compressor, a blasting tank, hose and nozzle, and a protective hood and clothing for the nozzle operator. Sand blasting procedures should be as follows:

1. Select sandblast materials that are clean, dust-free, and abrasive. These materials include mined silica sand, crushed quartz, granite or other abrasives. Abrasives must be selected for the type of materials to be cleaned, so damage of the masonry units or mortar joints will not occur.

2. Brick should be dry and well cured.

3. Remove all large particles as mentioned previously.

4. Protect all non-masonry surfaces.

5. Test-clean several areas at different distances and angles from the wall to find the best cleaning job without damaging the wall surfaces.

Caution: Light and heavily sanded, coated and slurry-finished brick must not be sand blasted.

Table 4-5: Cleaning Guide For New Masonry		
Brick Category	**Cleaning Method**	**Remarks**
Red and red flashed	Bucket and brush hand cleaning High pressure water Sandblasting	Hydrochloric acid solutions, proprietary compounds, and emulsifying agents may be used. *Smooth Texture:* Mortar stains and smears are generally easier to remove; less surface are exposed; easier to presoak and rinse; unbroken surface, thus more likely to display poor rinsing, acid staining, poor removal of mortar smears. *Rough Texture:* Mortar and dirt tend to penetrate deep into textures; additional area for water and acid absorption; essential to use pressurized water during rinsing.
Red, heavy sand finish	Bucket and brush hand cleaning High pressure wash	Clean with plain water and scrub brush, or lightly applied high pressure and plain water. Excessive mortar stains may require use of cleaning solutions. *Sandblasting is not recommended.*
Light colored units, white, tan, buff, grey, specks, pink, brown and black.	Bucket and brush hand cleaning High pressure wash	Do not use muriatic acid!! Clean with plain water, detergents, emulsifying agents, or suitable proprietary compounds. Manganese colored brick units tend to react to muriatic acid solutions and stain. Light colored brick are more susceptible to "acid burn" and stains, compared to darker units
Same as light colored units, etc., plus sand finish	Bucket and brush hand cleaning High pressure wash	Lightly apply either method. (See notes for light colored units, etc.) Sandblasting is not recommended.
Glazed brick	Bucket and brush hand cleaning	Wipe glazed surface with soft cloth within a few minutes of laying units. Use soft sponge or brush plus ample water supply for final washing. Use detergents where necessary and acid solutions only for *very difficult mortar* stain. *Select the proper solution*, under Bucket and Brush Hand Washing. Do not use acid on salt glazed or metallic glazed brick. Do not use abrasive powders.
Colored mortars.	Method is generally controlled by the brick unit.	Many manufacturers of colored mortars do not recommend chemical cleaning solutions. Most acids tend to bleach colored mortars. Mild detergent solutions are generally recommended.

Section V: Reinforced Masonry Construction

Pages	36 - 38	Terms and Definitions
Page	39	Four Types of Masonry Reinforcement
Page	40	Masonry Accessories
Page	41	Controlling Cracks in Masonry Construction

Trainee Section Objectives

A. To identify the terms:

Bond Beam	Cavity Wall	Collar Joint
Column	Control Joint	Curtain Wall
Exterior Wall	Faced Masonry	Filled-Cell Masonry
Filler Wall	Grout	Grouted Masonry
High-Lift Grouting	Hollow Masonry	Joint Reinforcement
Ladder Bar	Lateral Support	Lintel
Low-Lift Grouting	Load-Bearing Wall	Masonry Wall
Non-Load Bearing	Partition	Pilaster
Reinforcement	Reinforced Masonry	Shear Wall
Structural Wall	Veneer	Wall Panel
Wall Pier	Wythe	

B. To identify types of reinforced masonry construction.

C. To identify masonry reinforcing materials and accessories.

D. To correctly stock reinforcing materials and accessories along with masonry units.

E. To learn methods of controlling cracks in masonry construction.

Terms and Definitions

Bond Beam	A horizontal reinforced masonry beam, serving as an integral part of the wall. Its principle purpose is to provide structural integrity and in-turn crack control. It may also serve as a chord (flange) member of a horizontal diaphragm provided reinforcement steel is made continuous for full length of the diaphragm.
Cavity Wall	A hollow wall built of masonry units so arranged as to provide a continuous air space within the wall (with or without insulating material), and in which both the inner and the outer wythes of the wall are reinforced so as to separately resist seismic forces in proportion to their rigidities.
Collar Joint	The continuous vertical, longitudinal joint between two wythes of masonry.
Column	A compression member, vertical or nearly vertical, the width of which does not exceed three times its thickness and the height of which exceeds four times its least lateral dimension. Any portion of a bearing wall not bonded at the sides into associated masonry shall be considered a column when its horizontal dimension does not exceed three times its thickness. The least nominal dimension of every masonry column or wall pilaster shall not be less than 12 inches. No masonry column will have an unsupported length greater that eighteen times its least nominal dimension.
Control Joint	A continuous vertical joint in a wall designed to accommodate movements resulting from temperature and moisture changes.
Curtain Wall	An exterior, non-bearing wall built outside the building frame, generally with vertical support at ground level only, but may be (and generally is) laterally supported at each story level by anchoring to floors, roof or spandrel beams.
Exterior Wall	Any outer wall serving as a vertical enclosure of the building.
Faced Masonry	Masonry construction in which the structural-bonded facing and backing are of different materials.
Filled-Cell Masonry	Single-wythe masonry construction composed of hollow units in which all voids are filled with grout after the wall is laid.
Filler Wall	A non-bearing wall in skeleton frame construction, built between steel or concrete columns and wholly supported at each story.
Grout	A mixture of portland cement, aggregates and water which is proportioned to produce pouring or pumping consistency without segregation of the constituents. Used to fill voids and cells, or collar joints in masonry walls so as to encase steel and bond units together for composite action.
Grouted Masonry	Multi-wythe masonry construction in which the space between wythes is solidly filled with grout.

Terms and Definitions Continued

High-lift Grouting Method
: Indicates that grout will be pumped into all wall voids after the masonry units, reinforcing steel and embedded items are built to full story height. High-lift grout is placed in one continuous pour by lifts which allow time for consolidation and loss of water, but placed at such a rate as not to form intermediate construction joints or blowouts.

Hollow Masonry
: Single-wythe masonry construction composed of hollow units in which cells and voids containing reinforcing bars or embedded items are filled in with grout as the work progresses.

Joint Reinforcement
: An assemblage of steel reinforcing wires designed for use in masonry bed joints, serving to distribute stresses and to tie separate wythes together.

Ladder Bar
: Prefabricated joint reinforcing wires to which parallel deformed side rods are connected by perpendicular cross wires, forming a ladder design.

Lateral Support
: These are members such as cross walls, columns, pilasters, buttresses, floors, roofs, or spandrel beams which have sufficient strength and stability to resist the horizontal forces transmitted to them.

Lintel
: A beam located over any opening in a wall to carry weight of the construction and superimposed loads over opening.

Low-lift Grouting Method
: Indicates that grout will be poured in small increments as the masonry work progress.

Load-Bearing Wall
: Any wall which in addition to supporting its own weight supports the structure above it without benefit of a complete load-carrying space frame in structural steel or reinforced concrete.

Masonry Wall
: A vertical, plate-like element (whose horizontal dimension exceeds five times its thickness) constructed of stone, brick, concrete masonry units, glazed structural units or other suitable masonry materials.

Non-Load-Bearing Wall
: Any wall which does not intentionally support the structure above it.

Partition
: Any interior wall.

Pilaster
: An integral portion of a wall which projects from either or both faces and may serve as either a vertical beam or column or both.

Reinforcement
: Structural steel shapes, deformed reinforcing bars or joint reinforcement embedded or encased in unit masonry in such a manner that it works with masonry in resisting stress.

Terms and Definitions Continued

Reinforced Masonry	Masonry units, reinforcement, grout, and mortar combined in such a manner that the component materials act together in resisting seismic forces.
Shear Wall	Any wall which resists a horizontal force applied in the plane of the wall (i.e. any wall not isolated along 3 edges).
Structural Wall	Any wall which supports vertical loads other than its own weight or which resists lateral movement from horizontal forces such as those caused by an earthquake.
Veneer	A masonry facing which is attached to the backup but not so bonded as to intentionally act with it under load or movement. To limit potential damage, the use of veneer construction will be restricted to masonry veneers of less than 1 1/2 inches nominal thickness, such as ceramic tile. Otherwise, use faced construction.
Wall Panel	A wall segment in one plane which lies between: (1) wall end, (2) control joints, or (3) a control joint and wall end. Each wall panel is considered to be a separate vertical structure.
Wall Pier	An upright part of a wall between (or adjacent to) openings, the width of which does not exceed five times its thickness and the height of which does not exceed two times its width. Design as a column if height exceeds two times width or if width is less than three times the thickness; design as a wall if height does not exceed two times width and if width exceeds five times the thickness.
Wythe	Each continuous vertical section of a wall, one masonry unit in thickness.

Reinforced Masonry Construction

There are four types of reinforced masonry walls:

1. Reinforced grouted masonry is constructed with two wythes of masonry units. The "collar joint" or the space between the two wythes is reinforced and grouted solid. When building the wall the reinforcing steel is placed first along with other embedded items such as electrical conduits. Units are then laid in running bond on both sides of reinforcement. Wall ties must be used to hold the two wythes together when grouting. Collar joints should not be less than 3 1/2". Clean outs must be provided at the bottom of each grout pour to remove mortar droppings and debris. Reinforcement should be placed to allow at least 3/4" grout covering on all sides.

2. Reinforced hollow masonry is a single wythe wall of hollow masonry units which is reinforced vertically and horizontally with deformed steel bars. The vertical bars are placed first and horizontal bars are placed as the courses of block are laid. The cells which contain reinforcement are grouted as the work progresses.

3. Reinforced filled-cell masonry is also a single wythe wall of hollow masonry units reinforced horizontally and vertically with reinforcing bars. Horizontal bars are placed as the block are being laid. After the wall is constructed to full height the vertical bars are placed and the wall is grouted solid in one continuous pour of several lifts to allow for consolidation and loss of water.

4. Reinforced faced masonry walls are constructed with two different width masonry units and the facing and backing units are of different materials. Usually concrete masonry units form the backing and glazed structural units or brick form the facing.

   The two wythes are tied together with joint reinforcement. Spaces between facing and backing and the areas where reinforcement bars are placed are filled with mortar as construction of the wall progresses.

Placement of reinforcing steel can be performed by simply laying the steel in the masonry or pre-fabricated cradles can be used to hold the reinforcing steel in place.

Masonry columns and pilasters can be reinforced and grouted with four #4 bars. Columns and pilasters should not be less than 12 inches square or have an unsupported height of more than 18 times its nominal dimensions.

Bond beams and lintel beams can be constructed using reinforcing steel bars embedded in concrete or grout. Bars should be lapped at least 24 inches and splices should be staggered in bond beams. In lintel beams the bars should extend 24 inches past the face of the openings.

The amount of reinforcing steel and the type of masonry wall construction will vary according to geographical architecture, size and type of building being constructed, and the location of the building in different seismic zones. Buildings constructed in seismic zones with higher activity will require much more reinforcing than buildings in zones with less activity.

Masonry Accessories

Accessories used in masonry construction include:

- Wall Ties
- Insulation
- Flashing

Wall Ties

Wall ties are used to secure veneer brick to the backing wall and to connect two wythes of masonry together. These ties are made of wire or sheet metal depending on the backing material. When fastening veneer brick to wood studs a 7/8" x 7" corrugated sheet metal tie is used. They are nailed onto the wood studs and bent up into the mortar joint. Stronger 1 1/4" wide ties are "L" shaped and are made of about 16 gauge material.

In new concrete wall construction dovetail slots are poured into the wall and for existing concrete walls channel slots are mounted on the wall. Triangular ties made of 3/16" wire or corrugated metal ties are used. Three types of wall ties are used to attach brick to concrete masonry walls. Square box ties 2 to 4" wide and 6 to 12" long are used for masonry with aligned courses. Two types of adjustable ties are available for masonry with mis-aligned courses.

Fastening brick or block to steel is done using either weld-on or hook-on type anchors. Anchors are welded on structural steel in the field or at the fabricating shop before delivery. The welded rods, usually 1/4" allow for for vertical adjustment and use 3/16" triangular ties. 4" wide, 7" long and 1/8" thick hook-on ties can also be used to anchor masonry to steel.

Tie spacing varies from 16 to 24" vertically and 16 to 36" horizontally depending on the type of wall construction.

Joint reinforcement can also be used to tie veneer walls and two-wythe walls together. Applications of joint reinforcement ties and adjustable unit ties vary with the project.

Insulation

Insulation for masonry walls is available in 4 forms: rigid boards, pumped foam, loose-fill, and pre-formed inserts. Table 5-1 shows several types of insulation, their "R" value per inch of thickness and in what form they are produced.

On exterior wall surfaces, rigid foam board insulation such as Polyisocyanurate or extruded polystyrene is used. They can be attached with adhesive or mechanical fasteners. Above grade insulation must be covered with a durable, weather resistant coating, This insulation practice is usually used when remodeling old buildings or on new buildings in warm areas. Interior wall surfaces are insulated with the same materials as exterior walls. Interior applied insulation is usually covered with gypsum board or wood paneling. Certain commercial and industrial applications can be left exposed.

In cavity walls, granular materials, rigid board, or foam insulation can be used. A vapor barrier may be required on the cavity side of the inner wall or the cavity may have to be widened to allow an air space between the insulation board and the outside wythe of the wall.

Filling the hollow cores of concrete block can be accomplished using loose-fill granular, pre-formed inserts, or pumped

Table 6-1: Forms of Insulation for Masonry Walls

Material	"R" Value/inch	Form
Perlite	3.13	Loose-fill Granular
Vermiculite	2.44	Loose-fill Granular
Expanded Polystyrene	4.00	Loose-fill Granular or Rigid Board
Extruded Polystyrene	5.00	Rigid Board or Pre-formed Inserts
Polyisocyanurate	7.20	Rigid Board
Rigid Glass Fiber	4.00	Rigid Board
Polyurethane Foam	5.88	Pumped or Poured Foam

foam insulation. Loose-fill materials are usually poured into the cores in lifts. Vermiculite and Perlite is usually poured in 6 to 8 course lifts, but can be poured in lifts up to 20 feet. Lighter weight expanded polystyrene beads must be poured at 4 to 5 course lifts to obtain complete filling of the cores. Pre-formed polystyrene inserts can be installed at the block plant or in the field.

Flashing

Flashing is a thin waterproof material used in masonry construction to prevent water from penetrating certain areas of the wall. Water can enter walls at parapets, at shelf angles, window and door lintels and sills, and at the base of walls.

Masonry accessories are usually installed by the masons, but mason tenders must know when and where they are needed to keep the masons supplied and productive. These materials must be stocked along with masonry units and mortar as the wall is being constructed.

Controlling Cracks in Masonry Construction

Control joints and joint reinforcement provide the best means of controlling cracking in masonry walls. Control joints allow movement and joint reinforcement increases tensile strength and crack resistance.

Typical control joint locations

1. At major changes in wall height or thickness.
2. At construction joints in foundation, roof and in floors.
3. At chases and recesses for piping, columns, fixtures, etc.
4. At abutment of walls and columns.
5. At return angles in "L", "T", and "U" shaped structures.
6. At one or both sides of wall openings.

Joint reinforcement should not extend through control joints. Control joints are usually placed at one side of an opening that is less than 6 feet in width and at both jambs of openings more than 6' in width.

Control joints should be placed every 50 to 60 feet in non-reinforced masonry and at 100 foot intervals in reinforced masonry. For control joints to perform according to design, they must provide: stress relief, shear strength, and water-tightness.

Section VI: Advanced Scaffolding Techniques

Page	44 - 46	Irregular Terrain Scaffolding With Tubular Frame
Page	46 - 47	Circular Shape Scaffolding With Tubular Frame
Pages	48 - 50	Tube and Coupler Scaffolding Erection

Trainee Section Objectives

A. List and identify scaffold components used to erect tublar frame and tube and coupler scaffolding systems

B. To learn a variety of scaffolding tie-off methods.

C. To learn to safely erect tubular frame scaffolding on a slope.

D. To learn to safely erect tubular frame scaffolding in a circular shape.

E. To learn to safely erect tube and coupler scaffolding in irregular shapes.

Irregular Terrain Layout & Assembly

The most important consideration on any scaffolding set up is the foundation that the scaffolding will be placed on. Without a sound base the scaffolding will not be level and plumb and is likely to tip over. So the first step is to insure that the first frame section of scaffolding is resting on solid ground. In order to do this, the ground between the mudsills should be firm and level. On sloping terrain the mudsills can be installed at a right angle to the proposed platform as shown in Figure 6-1. This will save time and effort since less excavation will be needed. Planks that can no longer be used on the platforms can be used for mudsills. These planks are called cull planks. It is a good idea to mark "cull planks" on these planks so that they are not used on the scaffold platform. Cull planks can be made into smaller mudsills to hold the weight of the scaffold, but you must take the ground conditions into consideration. If there is a good solid base to build on, then single mud sills, under each frame leg, that are 2" x 12" x 24" can be used instead. Using these smaller mud sills will also save you from extra excavation work.

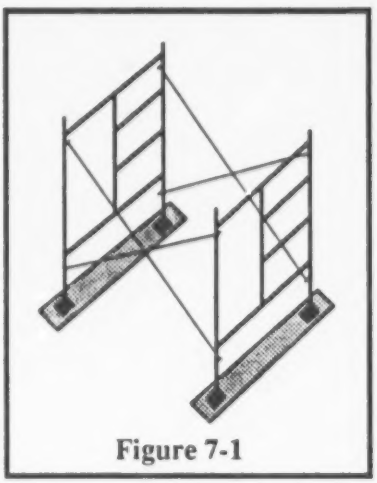


Figure 7-1

If there is a difference in elevation between one mudsill and the other, it must be within the adjustment range of the screwjacks, or further excavation will be required to place the mudsills within the screwjack range.

Caution: The screwjack can not have less than 12" inside the leg of the scaffold frame as shown in Figure 6-2.

Once the mudsills are in place and the frames are mounted on the screwjacks, the frames should be raised roughly to the same level with each other, before installing the cross braces.

In order to prevent the base plates from slipping off the mudsills, each base plate should be nailed down with 2-16d duplex nails, set diagonally at least 2" deep and pounded over.

Since both frames are approximately the same height, the cross braces will be easier to install at this time.

There are several levelling techniques that can be used when setting up scaffold frames. The laser level or the surveyors level would be the most accurate. This amount of accuracy may not be needed when building scaffold two or three frames high but might be crucial when the scaffold has to be erected to great heights.

A levelling technique that can be used on scaffold 3 or 4 frames high involves leveling the first frame then placing the level on the frame bearer next to one of the frame legs and levelling straight across to the next frame leg. Use straight 2 x 4 lumber, pipe, plank, or whatever you prefer, as long as it has a straight edge. Adjust the screwjack that is directly below where the level is resting. Then place the level, straight up and down, against the second

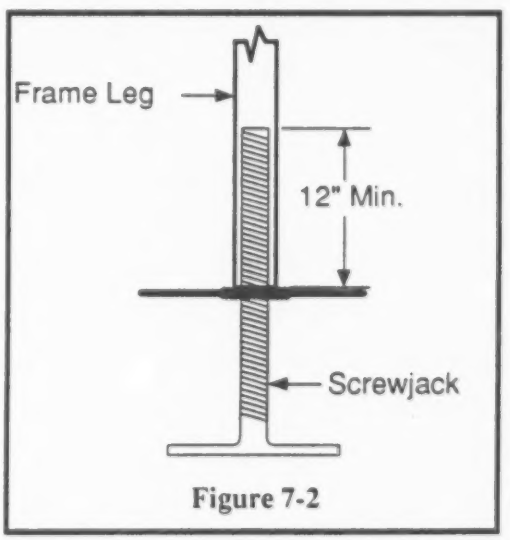


Figure 7-2

frame and check for plumb. Adjust for plumb by raining or lowering the screwjack under leg 3 as shown in Figure 6-3.

The levelling process can be double checked by putting the level across the bearer on the frame.

Diagonal levelling is another way you can level. Level diagonally from one frame leg to another by placing the level on the "load bearing" part of the frame, where you would normally place the plank. Level diagonally, across from the other two frame legs, using the same procedure as shown in Figure 6-4. When using this method, both frames will be level and the frame legs will be plumb. The type of levelling process can also be double checked just like in step #4 in Figure 6-3.

Attach a cross brace to the second frame, so that the end of the brace hangs out over the location where the next frame will be set up, so that the location and elevation of the third frame can be found. If the terrain slopes upwards, a smaller frame can be used to make up for the higher elevation. Measure the distance from the lower part of the cross brace to the ground and check which size frame will fit with the least amount of excavation. Once this distance has been found the proper sized frame can be selected. Most frames have different spacing from the bottom "brace to frame", to the bottom of the frame leg.

Select the frame that would fit the best once it is attached to the brace. Do not forget to take into account the screwjack height when you are deciding which frame will fit best.

The distance between the top of the brace and bottom, once it is attached to the frame, can change, depending on the size of the frame and the manufacturer. That is why when different size frames are used, some braces will not match up to every brace to frame connection. Federal OSHA standards state that these connections must be adequately secured. Sometimes these braces are wired to the frame in the field. Only a test by a qualified engineer could properly determine whether or not these braces are adequately secured.

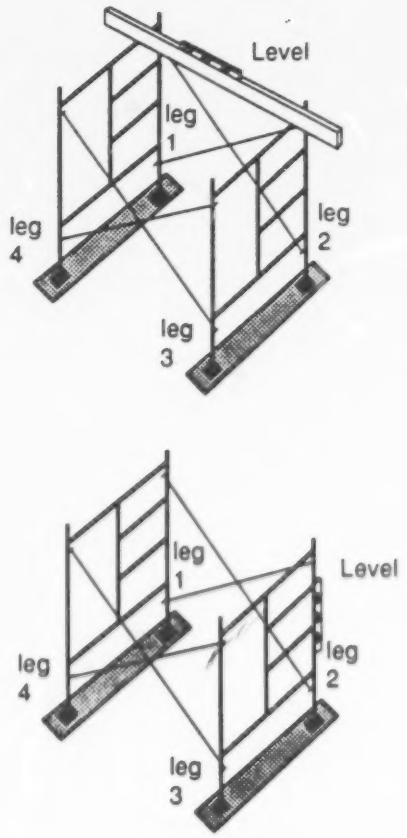


Figure 6-3

Frame Leveling Process

Level Frame 1, then level to leg 2 on frame 2.

Check plumb on frame 2 and adjust by raising or lowering leg 3.

Double check level by placing the level on the bearer on frame 2.

One method that is safer and probably more secure, involves the use of tube and coupler to hold the frames together.

Instead of braces, a total of 4 tubes can be placed horizontally across the two frames, near the top and the bottom, to lock the frames together. If tubes are installed on the frame leg next to a wall, you must place the top tube in a location where it will not interfere with the side bracket. The diameter

on the frame leg is 1-5/8 x 2", and the tube diameter is 2 inches, so a 1-5/8 x 2" clamp is used to attach the two frames. The nuts on the clamps should only be finger tight until the last frame has been plumbed and levelled. If the clamps are tightened right away the rest of the scaffold may be knocked out of level, as the screwjacks are adjusted to level the last frame.

Circular Design for Tubular Frame Layout and Assembly

Whenever you have to attach a lot of scaffolding frames together, it is important to begin the set up procedure on the highest elevation point. When you begin the assembly on the high ground, the screwjacks should be screwed down about an inch from the baseplate. As the elevation drops lower and lower, the screwjack can be used to raise the frame higher and higher, to keep the frames level across the top. If the screwjack no longer has 12" within the frame leg, you may have to place two mudsills under the screwjack or use a larger frame.

A single bay can be set up at the highest elevation and other bays can be added alongside the first bay, levelling as you set up each bay. When this common "running" technique is used for large circular layouts, it is important to measure the distance from the outside leg of the first bay to the outside leg of the second bay, as well as measuring the distance from this same outside leg to the wall. The distance from the wall of the outside leg of the second bay will depend on the total width of the bay plus the length of the side bracket, including the 2 finger spacing from the wall.

You will have to place the two bays far enough away from each other so that the planks that are available will fit into the span between the bays. The plank must overlap at least 1 foot across each bay. Once you have decided on the right plank and the proper distance between the bays, the other bays that will be added to the "run" will be easier to install. Once you have decided on the proper span between the bays you can begin to place the planks from the inside of the bay to the outside of the bay. When placing the first plank to the inside of the platform the spacing of the plank from the frame leg can be determined quickly. As you set the plank down, grip the frame bearer with your hand and set the plank 4 finger lengths away from the leg. The proper spacing must be left at the inside leg so that the side bracket can be put into place later on without having to lift or move any planks on the main deck.

The distance between the outside legs will also depend on the length of the planks that are available. Once the distance is known a plank that will overlap at least 1 foot across each bay can be put in place.

The brace sizes that are installed on the frames can vary in size depending on the circle circumference. The same size braces can be connected to the outside frame legs and to the inside frame legs, next to the wall. It is better if the frames are placed square to the wall and if the scaffold bay is shaped like a rectangle it may be difficult to place the frames square to the wall. That is why the brace that is attached to the inside frame leg should be shorter in length than the brace on the outside frame leg. When the bay is built in the shape of the trapezoid it is easier to square the platform to the wall. If the bay is trapezoid shaped, the planks to the outside of the platform may have to be longer than the planks to the inside of the bay, depending on the span between the outside frame legs.

The length of the planks also depends on whether or not the spacing between the foot planks and the wall will be at the proper distance. Sometimes if a plank is too long or if the circle is too tight, the plank will be too far out from the wall at the point where the frame leg is sitting next to the wall, even though the middle of the plank might be at a proper 2 finger distance from the wall. The foot planks should never be any more than 1 foot away from the wall. If a larger gap can be found in this space, material and even masons can fall through this space.

There is another technique that can be used

to set up scaffold in a circle. It is a method that can be used to place scaffold around a small circle. The "quartering method" splits the circle into 4 equal quarters. The first 4 bays split up the circle into equal parts. After this is done, other bays are placed between the original 4 bays and the scaffolding is fully planked.

One of the dis-advantages of the quartering method is that it can take longer to level the frames. When each bay is erected, you have to guess the elevation of each frame section as you set it up, so the rough levelling is very rough at the start. You can only begin to level properly after the first 4 frames are set up and you have begun to build the first quarter section of scaffolding. It is always easier to pre-set the screwjack to the proper height before it has been placed into the frame. When you use the quartering method you may have to do a lot of screwjack screwing after the frame has been placed over the screwjack, since screwjacks may have to be adjusted great distances, in order to level the frames.

The first set of frames should be erected at the highest elevation point around the circle so that the screwjacks can keep the frames level. A line should be drawn through the center point of the circle so that the first two bays will be placed directly across from one another. This can be done by standing behind the line to line up each bay, one at a time. To place bay #3 and bay #4, some basic measurements must be taken.

To find the center of bay #3, you must measure between the center point of the circle to the outside edge of foot plank #1 on bay #1 or #2. Once you have made this measurement you can multiply it by 1.414.

To find the center on proposed bay #3, as well as the foot plank location, all that needs to be done, is to measure the same dimension from the center of the tank and at the same time, measure the diagonal distance you calculated from the middle of bay #2. Wherever the two measurements intersect is the location where the middle of the bay and the edge of the foot planks on the proposed bay will be placed. The point that you have found is exactly 1/4 the distance around the circle away from the middle of either bay #1 or #2.

In order to place the fourth bay, the same measurements and procedure can be used. Once these first four bays have been erected, other bays can be placed between the first 4 bays an equal distance apart.

The frames must be levelled before they are planked together. After they are levelled the bays should be fully planked. You should be aware that short foot planks may need to be placed in every second space.

The frames should be tied off with tube and clamp so that the frames are sturdy and safe. Whenever a gap exists between 2 bays, a total of 4 tubes should be used to tie the frames together. Remember that 1-5/8" x 2" clamps will be needed, and the tube and clamp, installed next to the wall, has to be placed so that they do not interfere with the side brackets.

Tube and Coupler Scaffolding

Tube and coupler scaffolding can be used to build an independent structure, or it can be used in a variety of situations to improve the safety factor on a frame and brace system of scaffolding. For instance, tube and coupler can be attached to an independent system of frames so that the minimum base dimension of the structure can be increased, allowing a scaffolder to build the structure safely, even though it will be built even higher. This can be really helpful when you do not have any place to tie off the frames to steady the scaffolding. Mason frames are almost always 5' wide. The width of the scaffold is usually the smallest diameter. This happens to be the case because the common dimensions are usually 5' wide by 7' long, or 5' wide by 8' long. If there is no tie off point the scaffolding can not go any higher than 3 or 4 times the minimum base dimension, depending on amount of safety that has been implemented on any one job. A scaffold could not go any more than 15 or 20 feet high, without needing to be tied off. In this situation the minimum base dimension could be increased by adding outrigger tube and clamp to the increase the minimum base dimension.

In the diagram the minimum base dimension, has been increased to 15 feet. This does not mean that the scaffold can be built to 45 or 60 feet. You have to realize that the minimum base dimension has now changed to whatever the distance the braces have made the scaffold. If another frame was attached by an 8' brace, then the scaffold could be built up to a height of 24 or 32 feet. This could only be accomplished if another set of outriggers where also attached to the next frame and these outriggers were attached to each other. This basic rule of safety seems to contradict Federal OSHA regulations, which state that a scaffold needs to be tied off at least every 26 feet vertically and every 30 feet horizontally, but this is not the case. The OSHA regulation is a minimum tie off requirement when there is a place to tie off. If a contractor needed to build a scaffolding that could not be tied off and you happened to know that by increasing the base dimensions, the scaffold could be built and it could be built safely, you would have to admit that the contractor would be very impressed with you. That little extra knowledge and skill you would bring to the job would make the contractor money and it would make you more valuable as an employee!

Scaffold building can become very inventive, challenging and even fun, when you use tube and coupler scaffolding. As an example, the configuration could be changed drastically but the outcome would be the same. For example, one set of frames could be placed on each side of the main tower and the add on sets could then be tied to the tower with tube and coupler. The possibilities could be endless.

Tube and coupler is also a system that can be built independently. In most situations tube and coupler is not a practical type to use since it is so slow to erect compared to other systems like frame and brace, tower or system scaffolding. There are some situations where it may be impossible to use any of the other systems, so tube and coupler is the only logical choice.

Safe Erection of Independent Tube and Coupler Scaffolding

Even though there are many different ways that tube and coupler can be erected, there are certain assembly procedures that are safer and more efficient than others. For instance, it is common to have 3 person crews setting up tube and coupler scaffold. It is easier, more efficient and safer to erect tube and coupler with a 3 person crew.

In order to set up an independent tube and coupler scaffold, a certain sequence should be followed. The next 7 steps will discuss the assembly process.

Step 1

One person will place a coupler at a pre-marked spot on the standard. The distance the measurement will be made will be 6" from the bottom of the standard. The

second person also puts their standard in place along with the coupler at the pre-measured mark. As the first two people do this, the third person places a stringer from standard to standard. Person #1 tightens the bolt clamp securely to the standard and the stringer, with a heavy duty scaffold ratchet. Once the clamp is tight, person #1 plumbs their standard while the third person levels the stringer. Person #2 must move their clamp up or down so that the stringer can be levelled. Before the second person tightens their clamp, they should attach their magnetic "torpedo" level to plumb the standard. When all three levels indicate that the section is plumb and level, person #2 can tighten their clamp.

Note: A clamp can be over tightened very easily. Usually the coupler will squeal loudly once it has been tightened enough. It is almost as if it is crying out for you to stop.

Step #3 and #4

Step 3 is a repetition of step 2, person #2 stays where they were when the stringer was being assembled. It is this scaffolders' job to hold the scaffold up while the other two partners pick up the next pieces for assembly. After this has been done, person #2 can secure the clamp tightly, while plumbing the standard. The sequence continues exactly as in step #1. Step #3 is done in the same way that step #2 is done.

Step 4

The three people continue working as a team in order to get the scaffold built quickly and safely.

Step 5 and 6

A little different technique is used to plumb the standard a second time. Two inch by two inch swivel couplers are placed on each standard. One coupler is loosely placed just underneath the stringer coupler in a location called the node point. A node point is a term that describes a location where many of the couplers meet. Person #2 places one other swivel coupler loosely around the standard about 12" from the bottom of the other standard. The tube is slide through the couplers until the tube comes into contact with the ground. The standards are plumbed and the clamps are tightened lastly. The same process is repeated for step #6.

Step 7

The bottom stringers are put into place at about 6" from the bottom of the standard. Six inches is always a good distance to place the bottom stringers.

Last Steps

The last steps include levelling the bearers on each end. After that is complete, the middle standards and bearers are attached. All the stringers and standards could probably be double checked for plumb and level really quickly at this time.

Now the planks can be put into place. Remember that a full platform is much safer than a partial platform. Tube and coupler top rails and mid rails can also be installed at this time.

Note: Stringers and bearers can be extended far enough into the wall so that foot planks that are 2 planks wide will be in place next to the wall.

When you are setting your scaffold in place, you may want to take a measurement to make sure that the standards are placed far enough away from the wall so that two foot planks can be put next to the wall. You should be aware of the OSHA standards regarding placement of cross braces when erecting tube and coupler.

Facade or sway braces should be installed once the scaffold is built a little higher.

A proper ladder will be the last thing that you will attach so that the assembly is complete.

You should always be aware how much the scaffold you are building can carry in weight. Many of the scaffolding accidents

in masonry work occur because the scaffold is over loaded. OSHA states that there are three main scaffold types according to the weight they can carry and also the size of the scaffold. These scaffolds are light, medium and heavy duty. A light duty scaffold, for instance, can carry 25 pounds of weight per square foot if the scaffold is 6' wide by 10' long:

6'x10' = 60 square feet

60 square feet x 25 lbs per sq. ft.
= 1500 lbs. Max.

This means that a pallet of block, which usually weighs more than 1500 pounds, could not be placed on the scaffold, even if the scaffold planks could resist the load without breaking. Scaffold plank also has weight restrictions that must be followed, so even if the scaffold could safely hold this weight, the scaffold planks may not.

GLOSSARY OF TERMS

Glossary of Terms

absorption	the weight of water a masonry unit will absorb when immersed in either cold or boiling water for a stated length of time. This weight is expressed as a percentage of the weight of the dry unit.
adhesion	the characteristic of mortar which enables it to cling to a masonry unit.
ASTM	an organization that sets standards for building materials. (American Society for Testing and Materials)
autoclave	a special metal cylindrical chamber used to rapidly cure concrete block; heat is approximately 360° F.
autogenous healing	the ability of mortar with a high lime content to reknot or heal itself if the masonry cracks. Moisture is necessary for this healing to occur.
backing up	the process of laying the inside masonry units of a composite wall after the exterior has been laid.
batch	the combination of materials used to produce concrete block.
blowout	the swelling or rupturing of a cavity wall caused by too much pressure from pouring liquid grout in a wall.
box anchor	a square metal tie used to tie two masonry units together.
breaking joints	any arrangement of masonry units which prevents continuous vertical joints from occurring in succeeding courses.
burning the joint	tooling mortar joints after they are too hard, shown by black marks, The black marks are cause by a reaction between the steel and the mortar joints.
calcium chloride	a chemical used to accelerate the setting time of mortar.
carrying the trig	the process of setting the trig brick in mortar on the wall
checkpoints	mason's folding rule marks placed every 16" on the footing or base; used as a reference when laying masonry units.
CMU	the abbreviation for Concrete Masonry Units.
compressive strength	the measured amount of downward pressure (load) that can be applied to a masonry material before it ruptures or breaks.
control or expansion joint	a vertical joint built into masonry work in places where the forces acting on the wall cause pressure, possibly creating cracks. The joint is filled with a material which will give flexibility, thereby relieving some of the pressure.
crowding the line	causing the line to swing or bounce with the brick or the fingers when laying brick; also called putting the thumb in the line.

cubic foot measurement	the method of measuring masonry materials that are 1'-0" long, 1'-0" deep, and 1'-0" wide.
cupping the mortar	a method of cutting and rolling mortar onto a trowel in a cupping motion from the mortar board.
details	in masonry, specific drawings of elements of construction such as lintel layout, flashing details, and installation of bolts used in the wall. These are shown on a larger scale to simplify necessary procedures.
double jointing	the process of applying mortar to both end of the closure brick as well as to ends of the bricks surrounding the area where the closure brick will be placed.
dovetail anchor	a metal tie in the shape of dove's tail which is used to tie masonry units to concrete walls.
drip strip	a strip of wood usually measuring 3" x 3/4" laid in the middle of a cavity wall to catch mortar droppings.
drowning the mortar	the trade expression describing a condition of mortar resulting from too much water added to the mix.
dry bonding	the laying out of bricks without mortar to establish the bond for the wall.
ears (of a block)	the ends of a stretcher block where the head joint is formed; found only on stretcher block which do not have square ends.
elasticity	the ability of mortar to stretch and give.
face shell bedding	a method of applying mortar to only the outside webs of a concrete block.
flush joint	a mortar joint which is even with the unit and in which there is no tooling done.
fluted block	concrete block made with projected vertical ribs on the face of block; used for textured walls.
foot boards	wooden planks laid on top of bricks or concrete block to allow the mason a higher reach when laying masonry units.
fullback	concrete block that has all of the cell webs cut out except the last one that holds the block together.
full header	a header course that consists completely of headers, except for the corner starting piece.
gingerbread work	the trade term given very decorative masonry work, especially that which is located on the cornice trim of homes.

Glossary of Terms

green staining	a reaction on masonry work caused by the salts contained in vanadium.
grout	(1) a very thin mortar which is poured between two walls for reinforcement; (2) a liquid concrete that is poured in the center of a reinforced masonry wall. Consists of portland cement, lime, and aggregates.
hacking	the procedure of stacking bricks on a pile with the use of brick tongs or carriers.
halfback	concrete block that has the insides of two cells cut out.
half lap (of unit)	the lapping of one masonry unit halfway over another.
header	a masonry unit that is laid over two individual walls, thereby tying them together.
head joint	the mortar that is placed vertically between the ends of bricks.
high-suction brick	a porous brick that absorbs moisture rapidly.
initial set	the initial drying of mortar which bonds it to the masonry unit.
joints	in masonry work, the mortar between the units.
masonry saw	saw powered by a gas or electrical motor used to cut masonry units, either wet or dry.
muriatic acid	an acid used to clean masonry work by mixing a percentage of water to acid. The acid solution works to break down stains and particles on the work.
overhand work	the laying of a masonry wall from the inside, with all work done from only one side of the wall.
parging	the application of a thin coat of mortar to the back of a wall to waterproof the wall.
plugging chisel	a chisel with a tapered blade used for removing mortar from joints.
plumb bond	the alignment of all head joints in a vertical position.
poultice	a paste made with a solvent and an inert material which is used to remove objectionable stains on brickwork.
proprietary compound	a chemical compound protected by a patent or copyright; used to clean masonry work.
puddling	the process of settling or consolidating grout in a masonry reinforced wall with a stick to prevent the formation of voids in reinforced section of the wall.

quarterback	concrete block that has the inside of two cells cut out.
reinforced masonry	a type of masonry work consisting of 2 tiers of masonry units with reinforcements of steel and grout in the center for extra strength.
return	the turn and continuation of a masonry wall in another direction from which it was started.
rock face block	a concrete block made in a mold which resembles a stone wall.
rough wall	a masonry wall which is not tooled; must still be plumb and level.
round joint	the trade name for a half-circular indentation formed in a mortar joint by use of a convex jointer.
rubbed joint	a flush mortar joint which has been rubbed flat with some type of material to receive paint or to simply appear flat.
sailor	a brick that is laid in a vertical position with the largest side facing the front of the masonry wall.
scaffold high	the height to which masonry walls are built when scaffolding is needed to complete the structure; usually 4 to 5 feet high.
setting up	the action of the mortar hardening.
slack to the line	the term which describes a masonry unit laid too far from the line.
snap header	a half brick laid in a wall to resemble a header.
solid masonry wall	a wall built of masonry units laid with full mortar joints between them and with no type of framing present.
tailing the lead	the process of aligning the ends of the courses on a corner.
T-bar tie	a heavy-gauge steel strap tie used to tie intersecting bearing walls to main walls. The tie bar is built into the opposite bed joints of intersecting walls.
texture	the arrangement of particles in masonry materials which accounts for the brick's appearance. The various effects created by tooling mortar joints are also considered part of the texture.
throwing a mortar joint	the trade term for the process whereby mortar is applied on a brick with a swiping motion to form a joint.
tight away	a term used to signal to the mason on the pulling end of the line that is all right to pull the line tight against the line pin.
trig brick	a brick on which a trig is placed to prevent the line from sagging.

wash	sloping application of mortar or cement which prevents the entrance of water into masonry work.
water-cement ratio	the relationship between the amount of water and portland cement used to make it into a paste.
water retentivity	a quality of mortar which prevents the rapid loss of water to masonry units through absorption; enables mortar to retain moisture.
web	the cross walls connecting the face shells of hollow concrete masonry units.
wire mesh or hardware cloth	metal wire, usually formed in 1/4" squares, used to tie walls which are not load bearing to masonry walls.
wire track	the trade term for metal wire joint reinforcement used to strengthen or tie 2 tiers of masonry units together to form one composite wall.
Z tie	a metal tie used to tie 2 tiers of masonry units together; may have drip crimp in the center.